A. M. L.

HUMAN

PHYSIOLOGY.

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CHAP. XIX.

THE NERVOUS SYSTEM.

We now arrive at the animal functions — those which consist of feeling and the exertion of a will, — those, therefore, which, in their nature, must be peculiar to animals.

The organs of these functions are, the *encephalon*, *spinal chord*, and *nerves*. These, together with bodies called *ganglions*, constitute the nervous system.

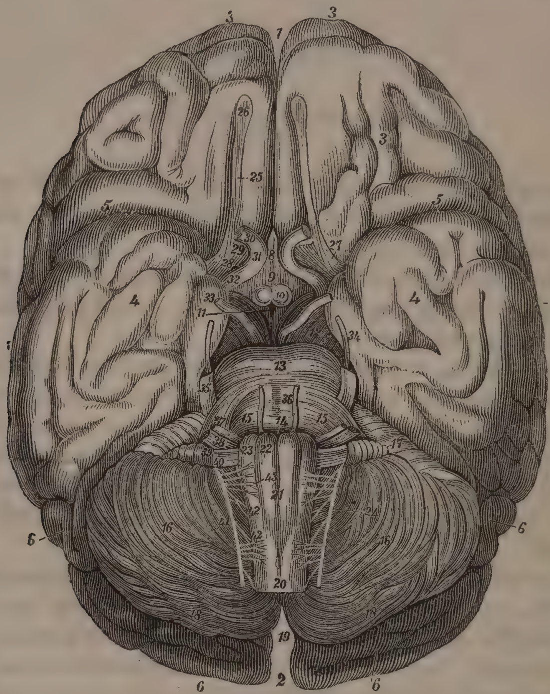
The *encephalon*, or brain, is encased in the cranium; the *spinal chord*, or improperly, spinal marrow, or spinal prolongation of the brain, in all the vertebræ, down to the first or second lumbar; the *nerves* pass through openings in the skull, between the vertebræ, and in the sacrum, and run in all directions through the system; while the *ganglions* are disseminated in the head, neck, and trunk.

The *encephalon* is the largest solid organ found in the cavities of the body, except the liver. Its substance is not firm, and on exposure to the air grows very soft. It consists of a pulpy and a fibrous portion. Its more external part, and some internal parts, are pulpy, and of various shades of ash colour and yellowish brown. The chief portion is fibrous and white. It is, therefore, said by some to consist of a cortical or cineritious, and of a medullary or white, portion: but what is not white is not always cortical, neither is its hue always cineritious; and the white fibrous portion is totally different from what is properly called marrow. Gall, therefore, more properly, says it consists of a pulpy and a fibrous portion.[a]

[a] "We could wish that the term *medulla* were banished from the nervous system. The functions of nerves are totally different from those of marrow, and infinitely more noble. Besides, the idea of marrow always excludes fibrous structure." (*Anatomie et Physiologie du Système Nerveux, et du Cerveau en particulier*, 4 vols. 4to. Paris, 1810—19, with an atlas of 100 plates Vol. i. p. 49.)

While some had said that the white part was all blood-vessels, others that it contained none, some that it, as well as the cineritious part, was all globules, some that it was solid, others tubular, Leuwenhoeck, Vieussens, and Stenon,

It consists of four masses: one many times larger in the adult than the second, and called *cerebrum ;* a second, called *cerebellum,*



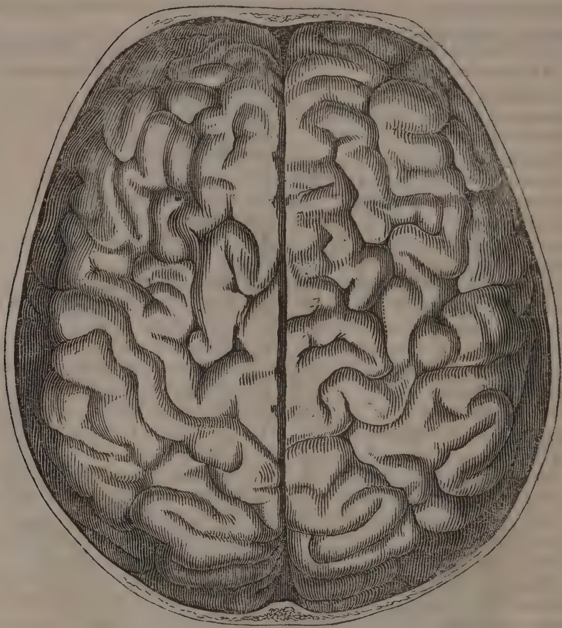
pronounced it fibrous; and Bonnet, Herder, and many others, conceived a fibrous structure so fit for the operations of the mind that they adopted this opinion. But Soemmering and Cuvier did not venture to consider it fibrous throughout; and many moderns, — the brothers Wenzel, for instance, — declared that, after repeated experiments and most careful observation, the brain was not at all fibrous, but equally pulpy throughout. Walter, Ackerman, and Bichat equally deny the fibrous structure of the brain, and speak of the white part as only medullary. (Gall, l. c. vol. i. p. 235.)

Professor Ehrenberg has lately found the proper substance of the brain and nerves to be fibrous, under a microscope with a power of magnifying to 300 or even to 800 diameters. In the white part of the the brain, he says, the fibres are straight and cylindrical, with others like strings of pearls: in the medullary, these knotted fibres only exist, contained in a dense network of blood-vessels, and interspersed with plates and granules. He declares the large cylindrical fibres to be tubular, and believes that the knotted are tubular also. All microscopical observations require careful repetition by many individuals. (Poggendorf's *Annalen der Physik und Chimie,* No. 7. 1833.)

1. Anterior extremity.
2. Posterior extremity, of the great central fissure of the cerebrum.
3, 3, 3. Its anterior lobes.
4, 4. Its middle lobes.
5, 5. Fissure of Silvius, separating the anterior from the middle.
6, 6. Posterior lobes.
7, 7. Convolutions of the external surface of the hemispheres.
8. Infundibulum.
9. Tuber cinereum.
10. Corpora pisiformia.
11. Grey substance between them; and,
12. The anterior prolongations of the mesocephalon, or crura cerebri.
13. Inferior surface of the mesocephalon, and the groove which lodges the basilar artery.
14. Groove separating the mesocephalon and the superior extremity of the chorda oblongata.
15, 15. Posterior prolongations of the mesocephalon, or crura cerebelli.
16, 16. Inferior surface of the lobes of the cerebellum.
17. Anterior, and
18, 18. Posterior, parts of the circumference of the cerebellum.
19. Fissure separating the lobes of the cerebellum behind.
20. Superior extremity of the spinal chord.
21. Central groove, which divides
22. The corpora pyramidalia.
23. Corpora olivaria.
24. Corpora restiformia.
25. Olfactory nerve,
26. Its bulb,
27. Extent,
28. Its middle, and
29. Internal, root.
30. Optic nerves after their decussation.
31. Their decussation.
32. Optic nerves before their decussation.
33. Common motor nerve of the eye.
34. Internal motor, or pathetic, nerve.
35. Trigeminus or trifacial.
36. External motor nerve of the eye.
37. Facial nerve.
38. Acoustic nerve.
39. Glosso-pharyngeal or gustatory.
40. Pneumono-gastric or vagus.
41. Accessory.
42, 42. Fibres of reinforcement of the accessory.
43. Roots of the hypoglossal, plunged in the groove between the paramidal and olivary bodies. (Gall.)

and placed below the posterior part of the cerebrum; a third, which unites these, is much smaller than the second, and called *mesocephalon* or tuber annulare or pons Varolii; and an apparent prolongation of this, still smaller, and termed *chorda oblongata* or medulla oblongata; an apparent prolongation of which, again, is the chorda, or medulla, spinalis.

The *cerebrum* is divided down to its middle into two equal portions, termed *hemispheres*. Each of these, again, consists of three portions or *lobes;* an anterior, a middle, and a posterior. The outermost part of the cerebrum is rendered far more extensive than the dimensions of the organ, by these divisions; and still more by being furrowed to about an inch in depth, the two sides of each furrow being in contact, so that what are termed *convolutions* exist. The inner surface of the small intestines is greatly increased by projections of the mucous membrane; the inner surface of the lungs, and of glands, by being divided into innumerable tubes and cells: whence there is far more absorption of chyle, far more changes of the blood and air, and far

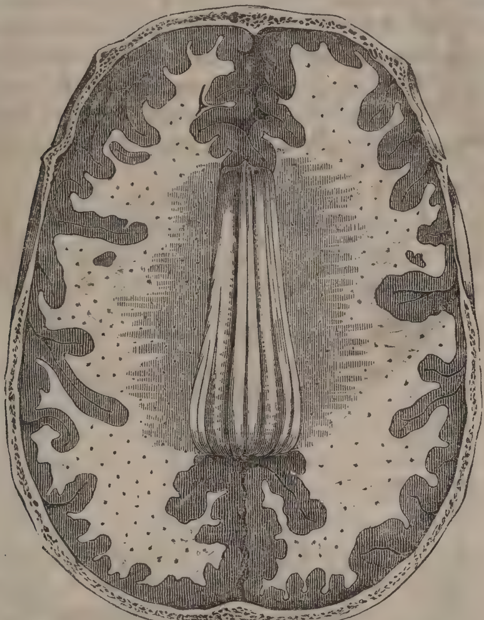


Superior surface of the cerebrum, narrower at the front than at the back; divided into two hemispheres, and consisting of convolutions. — In the cut at p. 304. the lobes are seen.

more secretion, in these respective parts, than there otherwise could be. As an equally beautiful contrivance augments the surface of the cerebrum, and of the portion immediately subjacent, we may be certain that the more external parts — those portions which are thus rendered more extensive (for the mass is rather diminished by the contrivance) are of the highest importance; and, as the inner surfaces, thus augmented, are all the seat of the functions of the respective organs, we may, perhaps, presume that, in the case of the cerebrum, the seat of chief function is the more superficial portions. Even a little more increase is effected by the summit of many convolutions being depressed. In the same way, the cerebellum is divided into two lobes, and these into sixteen lobules; the surface of each lobe consists of about sixty plates, standing side by side; and even in the sides of these are others, secondary, seen only on separating the primary, and amounting, perhaps, to 600 or 700. The purpose must be the same. We

shall find the surface farther augmented by cavities, and the surface of these cavities also increased by irregularities.[b]

On cutting the hemispheres of the cerebrum away by successive horizontal slices, we find the mass white and the outermost portions grey. When the hemispheres are entirely removed, a continuous surface remains, called *centrum ovale ;* the two halves

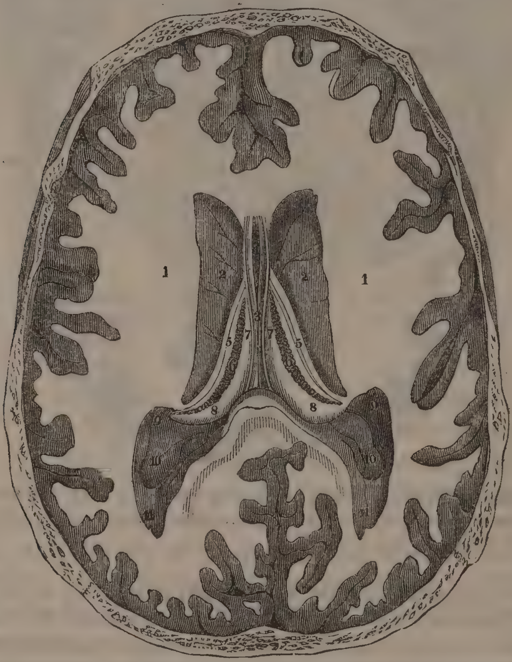


The cranium is external. The pulpy grey substance next. Then the fibrous white substance or centrum ovale. The mesolobe in the midst of it; and the raphè in the centre of this.

[b] M. Desmoulins contends, 1st, that integrity of surface is the only condition constantly necessary for the production of nervous actions; 2d, that these are proportionate to extent of surface; and, 3d, that they are performed by the surface, and transmitted from it. The energy of an electric apparatus depends very much upon surface. Dr. Spurzheim asks whether it is not on this account that the encephalic masses are hollow or convoluted; and remarks that the nervous masses of the lower animals are very commonly hollow. *The Anatomy of the Brain*, by G. Spurzheim, M.D., p. 206. London, 1826.

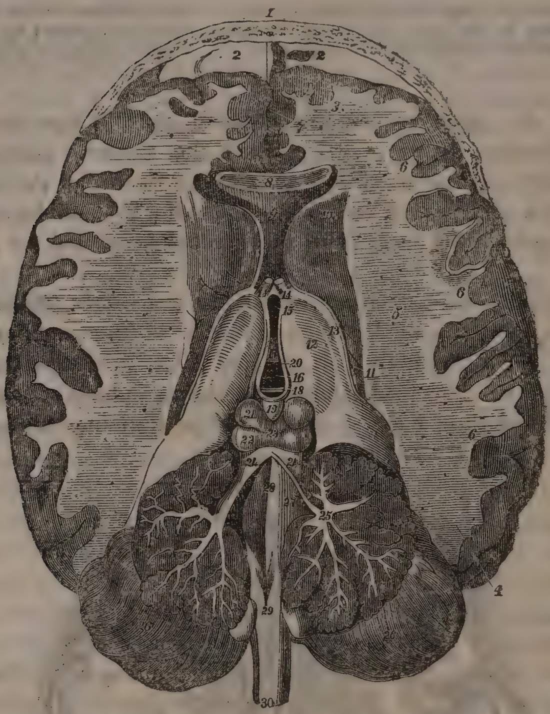
Dr. Macartney has lately declared that the surface of the human brain is thus proportionately more extensive than that of any other animal. *Second Report of the British Scient. Assoc.*, p. 454.

being united in the centre, and their commissure being termed *mesolobe* or corpus callosum. It has a longitudinal depression, called *raphè* or suture. When still more is removed horizontally, a large cavity appears immediately on each side of the centre, called the *lateral ventricle:* which runs forwards into the anterior lobe, making an *anterior cornu;* backwards into the posterior lobe, making a *posterior cornu*, ending like a finger, and thus forming what is called a *digital cavity;* and downwards into the middle lobe, making an *inferior cornu*. A septum exists between the two lateral ventricles, called *septum lucidum*, with a little space called the *fifth ventricle* between the two layers of which it consists. In each lateral ventricle is a white mass, called *thalamus*



Horizontal view of the cerebrum, sufficient being cut away to exhibit, 1, 1, the great mass of white fibrous substance, surrounded on the surface by the grey pulp. 2, 2. Corpora striata, and lateral ventricles. 3. Septum lucidum. 4. Fifth ventricle. 5, 5. Semicircular band separating the corpora striata from the thalami optici, upon which lie, 6, 6, the plexus choroides. 7, 7. Fornix. 8, 8. Its posterior pillars, turning round to face the fimbriated bodies. 9, 9. Part where the superior part of the lateral ventricles communicates with the inferior, which is not seen. 10, 10. Ergot. 11, 11. The posterior part or digital extremity of the lateral ventricles.

opticus, with two tubercles on its posterior border, called external and internal *corpora geniculata ;* a yellowish mass with white striæ, called *corpus striatum ;* a pale semicircular band, called *tænia semicircularis*, between the two ; and a plexus of vessels, called *plexus choroides.* The floor of the cavity has various prominences : one called *hippocampus major*, or *cornu ammonis*, which is a prolongation of the posterior extremity of the mesolobe in the inferior cornu; and a small one of the same kind in the posterior cornu, called *hippocampus minor*, or *ergot;* another called *corpus fimbriatum.* Under the septum is another long white body called the *fornix*, with a few transverse lines called *lyra* at its lower surface, extended over a *third ventricle*, which is placed exactly in the centre, and to which an opening leads at each side of the fornix from the corresponding lateral ventricle. The anterior extremity of the fornix divides into two pillars, which diverge and run down to two projections at the base of the brain, called *corpora mammillaria*, *pisiformia*, or *albicantia*, between which is a grey triangular plate, called *pons Tarini:* its posterior extremity does the same, and each posterior division itself divides into two, one of which is the corpus fimbriatum ; and between this and the thalamus opticus exists a chink through which the pia mater, or innermost covering of the brain, enters into the third ventricle and unites with the plexus choroides, which is, in fact, a plexus of vessels, connected by cellular membrane, called, in this part of the body, pia mater. At the posterior extremity of the fornix are seen four eminences, called *corpora quadrigemina ;* the two higher and larger called *nates*, or *c. q. anteriora ;* the two smaller and lower called *testes*, or *c. q. posteriora ;* and, before them all, is a grey body, called *pineal gland*, generally containing grit, and attached to the brain by two medullary prolongations only, which run to the thalami optici. Behind and below the corpora quadrigemina, is a fine layer of transverse greyish fibres, called *valve of Vieussens*, which is formed by three converging bands, named *processus a cerebello ad testes.* Three bands of white matter, called *commissures*, run transversely over the *third ventricle*, establishing more communication between the two halves of the cerebrum. The anterior part of the floor of the third ventricle is formed by the upper surface of a small grey body, called *tuber cinereum*, which runs downwards in a conical form under the name of *infundibulum*, and ends in a little mass called *pituitary gland*, and lodged in the fossa

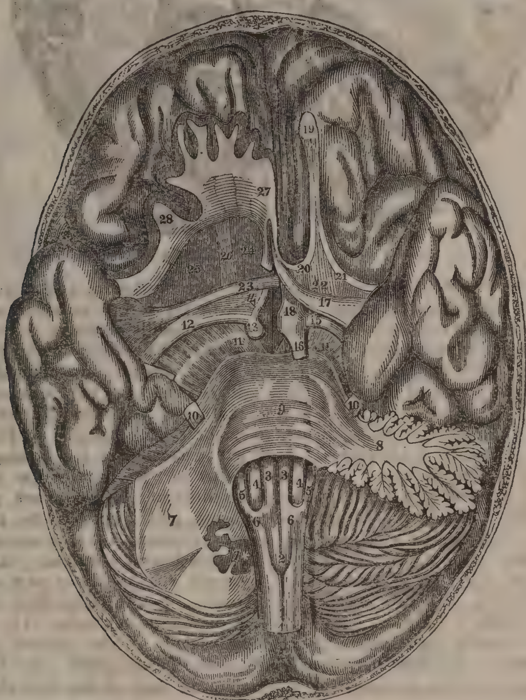


A transverse section of the brain, on a level with the lateral ventricles. The upper part of the corpus callosum, together with the fornix, removed, so as to expose the upper part of the lateral ventricles, the middle ventricle, the corpora striata, the optic thalami, tubercula quadrigemina, and the pineal gland with its prolongations. The valve of Vieussens and the cerebellum are divided in the middle line, and separated to expose the fourth ventricle and the calamus scriptorius. 1. Transverse section of the frontal bone. 2, 2. Cranial surface of its orbitar plate. 3. Anterior extremity of the cerebral hemispheres. 4. Posterior extremity of the same hemispheres. 5. White substance of the hemispheres. 6, 6, 6. Thin grey substance. 7. Anterior part of the interlobular fissure. 8. Cut in the anterior extremity of the corpus callosum. 9. Bent back portion of the anterior extremity of the corpus callosum, placed between the corpora striata. 10. Anterior extremity of the corpus striatum. 11. Posterior extremity of the corpus striatum, and upper part of the lateral ventricle. 12. Thalamus opticus. 13. Semicircular band between the thalamus and corpus striatum. 14, 14. Anterior pillars of the fornix, divided near their origin. 15. Anterior, and, 16. Posterior, extremity of the middle ventricle. 17. Nervous band or middle commissure, uniting the thalami in the interior of the middle ventricle. 18. Posterior commissure. 19. Pineal gland. 20. Medullary prolongations of the pineal gland in the internal part of the optic thalami. 21. Tubercula quadrigemina superiora. 22. Tub. quad. inferiora. 23. Crucial furrow between them all. 24, 24. Valve of Vieussens divided, and each half turned back. 25. Vertical section of the cerebellum and arbor vitæ. 26, 26. Superior surface of the cerebellum. 27. Fourth ventricle. 28. Central groove

running from the aqueduct of Sylvius and the upper surface of the cerebral protuberance to the upper surface of the spinal chord, and united to, 29. the cavity commonly called calamus scriptorius. 30. Upper extremity of the spinal marrow.

seen on the upper part of the ethmoid bone, before the corpora albicantia. (Cut, p. 304.) From the posterior part of the third ventricle a canal, called *aquæductus Sylvii*, or *iter a tertio ad quartum ventriculum*, runs back, under the base of the corpora quadrigemina, into a cavity in the cerebellum called the *fourth ventricle.*

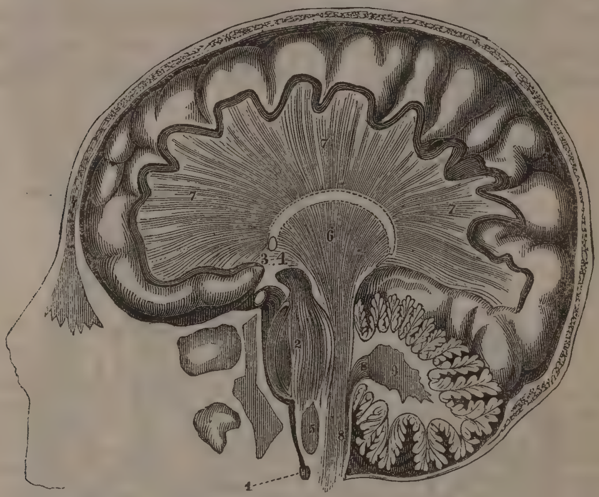
On cutting the *Cerebellum*, which has two lobes united by a projecting portion called *vermiform process* at the superior-anterior and superior-middle part, we find it less consistent than the other parts of the encephalon. Its fibrous substance within is collected into three masses; two lateral, and sending off prolong-



1. Continuation of the central fissure of the spinal chord. 2. Beginning of the anterior pyramids. 3, 3. Anterior pyramids. 4, 4. Corpora olivaria. 5, 5. Corpora restiformia. 6, 6. Cross band uniting the corpora olivaria. 7. Horizontal

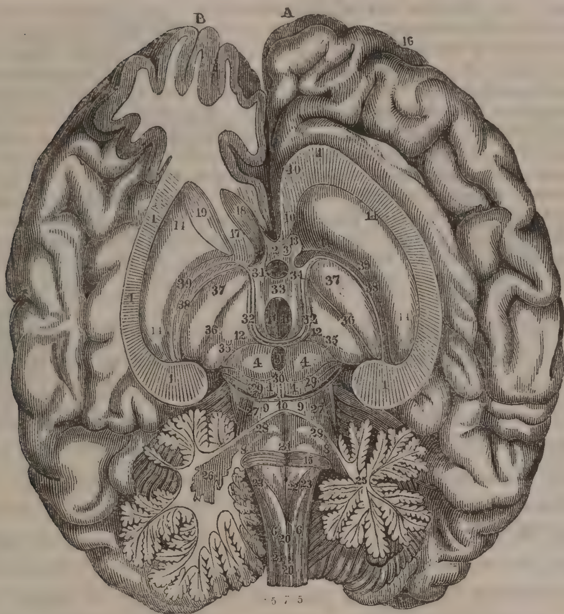
section of the cerebellum. 7*. Ganglion of the cerebellum. 8. Converging fibres of the cerebellum. 9. Commissure of the cerebellum or mesocephalon. 10, 10. Par trigeminum. 11, 11. Crura of the cerebrum. 12. Transverse interlacement below the optic nerve. 13. One of the corpora albicantia. 14. Prolongation of the corpus albicans towards an anterior pillar of the fornix. 15. Optic nerve. 16. Optic nerve just before their decussation, turned back. 17. Band of transverse fibres of the optic nerve. 17. Reinforcement of optic nerve at the decussation. 19. Olfactory nerve. 20. Its internal root. 21. Its external ditto. 22. Its middle ditto. 23. Anterior commissure. 24. Internal part of the great superior ganglion or corpus striatum. 25. External part of ditto. 26. The bundles of the corpus striatum. 27. Anterior plate of the corpus callosum. 28. Convolution at the bottom of the fissura Sylvii. — (Gall.)

ations like the tree called the tree of life, whence their name of *arbor vitæ;* and one central.



A lateral view of the encephalon, sufficient having been removed to show the interior of the chorda oblongata. 1. Origin of the anterior pyramid, or great original band of the cerebrum. 2. The fibres of the anterior pyramid entered into the mosocephalon or great commissure of the cerebellum, and enlarged in their passage through it. 3. Crura, or great fibrous bands, of the cerebrum. 4. Their locus niger. 5. The corpus olivare or oval ganglion of the great chorda oblongata. 6. The thalamus opticus or great inferior ganglion of the cerebrum. 7, 7, 7. The corpus striatum or great superior ganglion of the cerebrum. 8. Corpus restiforme or original band of the cerebellum. 9. Corpus dentatum or ganglion of the cerebellum. — (Gall.)

A smaller division of the brain, but the firmest, is the *Mesocephalon*, so named from its situation in the centre of the base, between the cerebrum and cerebellum, and over the spinal chord. (Cut, p. 311.) Two processes of the cerebrum, called *crura cerebri*, which contain some grey substance, whence the name *locus niger*,

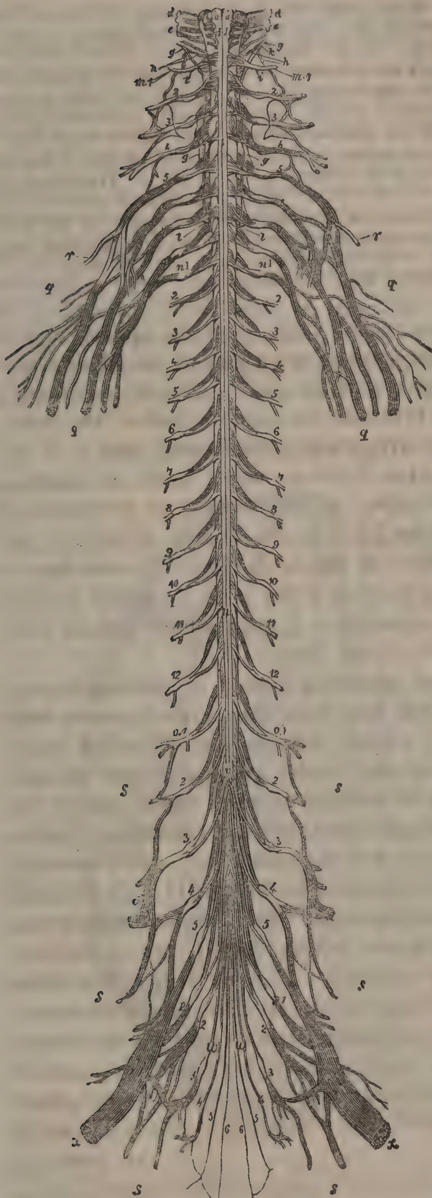


The brain placed upon its base. The knife has passed through the middle of the great commissure or corpus callosum, 1, 1, 1, 1, as far as the infundibulum 2, situated below the anterior commissure 3, and as far as the corpora quadrigemina 4, 4, 4, 4. The two hemispheres are separated and unfolded. The posterior and superior parts of the nervous mass of the spine and brain are seen. The grooves 5, 5, are continuous with the lateral grooves 6, 6. 7. The central fissure. 8, 8. The space before the fundamental part or processus vermiformis of the cerebellum open; viz. the fourth ventrical: it is in connection, by means of a canal situated below the mass of communication called the valve of Vieussens 9, 9, and below 10, with the third ventricle or space, 11, 11, in the midst of the great inferior cerebral ganglion or thalamus opticus 12. The septum lucidum or common mass of communication and fornix are cut at 13, on each side, and entirely removed, in order to expose the great cerebral ganglion 12, 12, and 14, 14, 14, 14. On the side A, all the inner surface of the cerebellum is seen cut vertically through the centre. On the side B, the cerebellum has been removed by a horizontal cut from within outwards, and from before backwards, on a level with the white fibres 15, situated in the fourth cavity or ventricle, the fundamental part or vermiform process, and what is seen of the anterior surface of the side A. By a vertical cut in the direction from 13 to 16 (side A), the anterior and inner part of the hemisphere B has been removed, to show the diverging direction of the nervous band above the great inferior ganglion or thalamus opticus, the very fine fibres of grey substance, the great bands 17 in the middle, the direction of this mass of grey substance in the internal part 18 and in the external 19, and the proportional size of each of these divisions. 20, 20. Commencement of the pyramidal bundle of the cerebrum. 21. Corpus restiforme or original band of the cerebellum. 22. Fourth ventricle or the space before the fundamental part of the cerebellum. 23. Entrance of the pyramids below the pons or great original band of the cerebrum beneath the commissure of the cere-

bellum. 24. Median line of the cerebellum. 25. Middle of the nervous mass of the fundamental part of the cerebellum. 26. Ganglion or corpus rhomboideum of the cerebellum. 27, 27. Mesolobe. 28, 28. Valve of Vieussens or mass of connection of the primitive part of the cerebellum with the corpora quadrigemina. 29, 29. Pathetic nerves. 30. Commissure of the corpora quadrigemina. 31. Pineal gland. 32, 32. Superior band of connection of the pineal gland with the great inferior cerebral ganglion. 33. Soft or middle commissure of the inferior cerebral ganglion. 34, 34. Mammillary bodies. 35, 35. Transverse interlacement of the great cerebral bundle. 36, 36. Transverse interlacement below the optic nerve. 37, 37. Optic thalamus or great inferior cerebral ganglion. 38, 38. Transverse interlacement of the nervous bands of the middle lobes. 39, 39. Transverse interlacements of the great superior cerebral ganglion. 40, 40. Fold of the corpus callosum or mass of union of the inferior convolutions of the anterior lobe. — (Gall.)

and two of the cerebellum, called *crura cerebelli*, appear to run to it. The corpora quadrigemina are a part of its superior, or, as it lies obliquely, posterior, portion ; and it, with its continuation —the chorda oblongata, furnishes the anterior wall of the fourth ventricle. This cavity is irregularly quadrilateral, and runs obliquely from the aquæductus Sylvii or iter a tertio ad quartum ventriculum, under the valve of Vieussens and processus ad testes, downwards upon the back of the chorda oblongata, and before the vermiform process of the cerebellum. On the floor of it, or, as from the oblique position of the parts we might say, the back of the chorda oblongata, is a groove which ends in a triangular depression called *calamus scriptorius*.

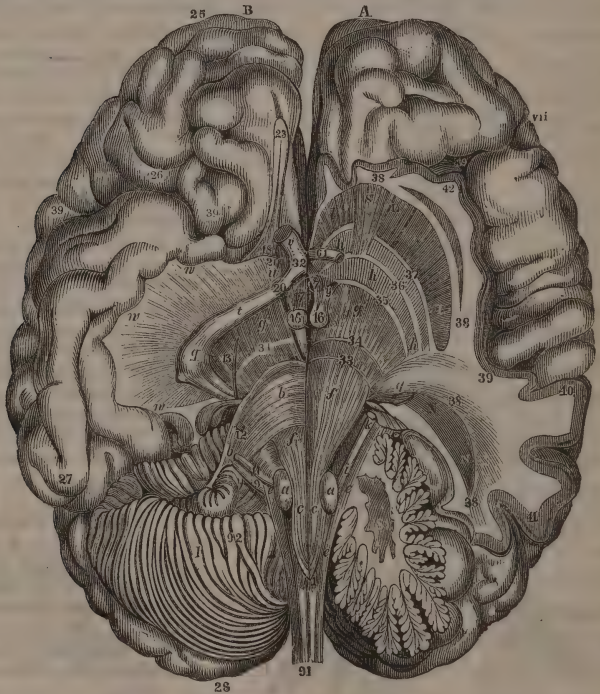
The mesocephalon, thus appearing formed of prolongations — two from the cerebrum, and two from the cerebellum — is itself apparently prolonged into a short bulbous chord, termed *chorda oblongata*, which lies upon the basilar process of the occipital bone. (Cut, p. 304.) On its anterior or lower surface (for it, like the mesocephalon, lies obliquely) are seen four elevations ; the two outer called *corpora olivaria*, the two inner *corpora pyramidalia*, or *c. p. anteriora*, or *anterior pyramids*. (Cut, p. 311.) On its lateral parts are two oblong prominences, called *corpora restiformia :* and on its posterior portion two others, called *corpora pyramidalia posteriora* or *posterior pyramids*. (Cut, p. 313.) This chord apparently prolonged becomes the *chorda spinalis*, which runs in the vertebral canal, from the foramen occipitale to the first or second lumbar vertebra, larger and smaller in various parts of its course : smaller at first than the bulbous chorda oblongata, it swells in the middle of the cervical region, diminishes at the end of this, swells again at the upper part of the loins, and diminishes through the rest of its course, till it ends in an oval



a, a, Anterior corpora pyramidalia of the chorda oblongata. *b, b,* Corpora olivaria. *c, c,* Corpora restiformia. *d,* Glosso-pharyngeal nerve. *e,* Pneumonogastric. *f,* Hypo-glossal. *g,* Accessory nerve. *h,* Posterior root of the first cervical pair. *i,* Anterior root. The posterior root in this, as in many subjects, gives a twig, *k,* to the accessory, and crosses before it to reach the anterior root. In this instance, not only is there a communication between the accessory and the posterior root of the first pair, but the accessory actually begins from a twig uniting the posterior roots together. *l,* First root of the accessory. *m,* 1, The first cervical pair, formed of its anterior and posterior root. *m,* 2, to *m,* 8, are the successive cervical nerves, with their two roots. *n,* 1, to *n,* 12, The successive dorsal ditto. *o,* 1, to *o,* 5, The successive lumbar. *p,* 1, to *p,* 6, The successive sacral. *q, q, q, q,* The cervical plexus, formed by the eight cervical and first dorsal nerves; and furnishing, among other nerves, *r,* The phrenic. *s, s, s, s,* The lumbo-sacral plexus, consisting of nerves furnished by the lumbar and sacral nerves. *t,* The cervical enlargement of the spinal chord. *u,* The lumbar enlargement. *v,* Its termination, where it splits into many nerves, called altogether, *w, w,* The cauda equina. *x,* The last nerve of the lumbro-sacral plexus, or sciatic. — (Dr. Manec.)

bulbous extremity. A fissure in front, beginning between the anterior pyramids, (Cut, p. 311.) divides it into two lateral halves. Another, less deep, beginning between the posterior pyramids, divides it posteriorly. Thus it appears two long chords, united in their middle line; for at the bottom of each fissure a layer of white substance is seen, running longitudinally in the form of two bands at the posterior fissure, and consisting of transverse filaments at the anterior, as Gall first pointed out. Two faint grooves are seen at each side, in the cervical portion; the one near the posterior, the other near the anterior, fissure. Its consistence is generally less than that of other nervous parts. It is composed chiefly of white fibrous substance; but in the midst of this is seen a fine layer of grey pulpy substance, very irregular in shape,—not solid, but, as Mr. Mayo mentions, really a capsule.

We will now trace the several parts of the encephalon.



B, Right side of the base of the encephalon. I, Hemisphere entire of the cerebellum. The primitive band or corpus restiforme *e e* of the cerebellum plunges

between the facial nerve, 11, and the acoustic nerve, 9. The trigeminus or fifth is still covered entirely by the transverse fibres of the cerebellum. The olivary ganglion, *a*, is prolonged below the transverse fibres *b* of the cerebellum; one part of the transverse fibres of the cerebellum is removed to show the continuation of the pyramidal band 1, *c, c*, which begins to diverge and be reinforced. Outside the optic nerve *q, t, v* is seen the expansion of the nervous bands, in the inferior convolutions *w, w, w* of the middle lobe 26, 27.

A, Left side of the base. A verticle cut of the cerebellum, directed through the entrance of its original bundle *e e*, and through the middle of its ganglion *s*, in the direction 92, 28, B, to show the reinforcement of the original bundle in the ganglion, and the ramifications and subdivisions of the nervous chords. All the transverse fibres of the cerebellum which cover the trigeminus *k, i*, and the prolongation *f* of the pyramidal bundle 1, *c, c*, are removed. The prolongation of the olivary ganglions *a, a* is still covered by the transverse fibres. The optic nerve is removed from the great fibrous bundle *g*, and cut at *v, q*. The pyramidal bundle is seen prolonged from the decussation 1, to the transverse interlacement 35, below the optic nerves. The grey mass 17 has been removed by scraping, to show the two cords of the mammillary bodies 16, 16; the one *y*, towards the transverse interlacement 35, the other, 7, towards the common mass of communication or fornix. The nervous fibres which spread out in the convolutions of the middle lobe, and contribute to its functions, are cut at *h, h, h* between 35 and 37, on a level with the anterior commissure; and the middle lobe is entirely removed. The mass of grey substance of the great superior ganglion of the brain, and a part of the convolutions situated below the great fissure, between the middle and anterior lobes, are cut in the same direction. We thus see how this great mass is divided by the nervous bundles S into an inner part *l*, and an outer part, L L; how the finest fibres are implanted in the grey substance; how the convolutions 40, 41 are formed by the posterior chords of the great fibrous bundle or crus placed before *q*, and what are the depth and length of the great fissure 39, 39 between the anterior and middle lobes. By the removal of the middle lobe, the posterior edge of the great cerebral cavity N N becomes visible. This cavity is prolonged inwards and forwards below the great fibrous bundle or crus *g*. Between 40 and vii. are seen the convolutions situated above the fissura Sylvii between the anterior and middle lobes. The anterior lobe is but slightly cut.

21. Internal root of the olfactory nerve. 18. Its external root. 23. Its bulb. 25, 26. Anterior lobe of the cerebrum. 27. Its middle lobe. 28. Its posterior lobe. 20. Optic nerve. 32. Decussation of the optic nerves. *v*. Optic nerve after its decussation. 33. Transverse interlacement of the upper edge of the great commissure of the cerebellum. 34, 34. Transverse interlacement of the great fibrous bundle. 36. Transverse interlacement of the nervous bundles of the middle lobe. 37. Tranverse interlacement of the great superior cerebral ganglion. 38, 38, 38, 38. Situation of the tissue of the two orders of nervous filaments. 13. Pathetic nerve. *b, b*. Pons Varolii. 91. Central fissure of the posterior part of the spinal chord. 61. Anterior commissure of the cerebrum. — (Gall.)

According to Gall [c], many primitive bundles of nervous fibres give origin to the cerebrum and cerebellum. The anterior and posterior corpora pyramidalia, bands proceeding immediately from the corpora olivaria, longitudinal bands which contribute to form the fourth ventricle, and many others concealed in the chorda oblongata, to the cerebrum; the corpora restiformia to the cerebellum.

The bands arising from the anterior pyramids are the only ones

[c] l. c. vol. i. 270. sqq.

which decussate; the two halves of the cerebrum, the cerebellum and spinal chord, being united by commissures. MM. Magendie and Desmoulins, just as Prochaska, Barthez, Sabatier, Boyer, Dumas, Bichat, and Chaussier did before them, deny the decussation; but it was known of old, as Gall remarks in his demonstration of it, and cannot be disputed. The following, from Mr.

a, Corpora olivaria; *b*, Corpora pyramidalia, seen to discussate at their lowest part, where are three sets of ascending fibres on each half — one turning from behind *c*, the corpora restiformia, another running straight, and the third decussating. This writer, however, speaks of them not as ascending, but descending.

Mayo, shows it well. This forms an exception to the rule observed in every other part of the cranial nervous organs, except the optic nerves and the fibres which run from the genitals to the cerebellum, of the nervous fibres, destined to each side of the body, running on the same side of the brain; and we hence explain why injuries of one side of the brain, causing paralysis, generally influence the opposite side of the body.[d] The spinal chord has no decussation, whence injuries of one side of it influence the corresponding half of the body. Decussation has not been discovered in the cerebellum; and vivisectors say that an injury of a cerebellic hemisphere affects the same side; but Gall found that extirpation of a testicle caused the opposite lobe of the cerebellum to shrink.[e]

After their decussation, the bands of the anterior corpora pyramidalia ascend on the ANTERIOR part of the chorda oblongata (called by Gall the *grand renflement*), enlarging as they proceed. As soon as they enter among the transverse fibres of the mesocephalon, called by Gall *the great commissure of the cerebellum*, they divide into many bundles, which are imbedded in a large quantity of pulpy substance, from which proceed many fibres,

[d] I have never known an exception to this; but exceptions are recorded, and probably some difference of situation is the reason of the difference of effect.

[e] l. c. vol. iii. p. 112. sqq. *Sur les Fonctions du Cerveau*, t. iii. p. 291. sqq. Dr. Vimont has repeated Gall's experiments with the same results. *Traité de Phrénologie humaine et comparée*, par J. Vimont, M.D. 2 vols. 4to. with an atlas of 120 plates. Paris, 1832—5. vol. ii. p. 233.

joining and augmenting them while passing through this ganglion, for such it really is ; so that they come out increased enough to constitute, on the anterior and outer part, at least two thirds of the crura cerebri, or, as Gall terms them, *the great fibrous bundles of the hemispheres*. They contain a large quantity of pulpy substance, and enlarge the most at their superior extremity, where the optic nerve turns round them. Their filaments and bundles leave the great fibrous mass at the anterior or outer side of the optic nerve, and, diverging more and more, form the lower, anterior, and outer convolutions of the anterior and middle lobes, which, with the anterior and outer part of the crura and ganglion in the mesocephalon, are always in direct proportion to the pyramids. (Cut, p. 311.)

The corpora olivaria are true ganglia. A large bundle proceeds from each, and ascends with the POSTERIOR bundles of the chorda oblongata among the transverse fibres of the mesocephalon, like the bundles of the pyramids, but acquiring fewer additional fibres than these from among the pulpy matter. On leaving the mesocephalon, they form the posterior and inner part of the crura cerebri. They acquire their greatest increase on entering the crura, on account of the large quantity of pulpy substance which is there, called *locus niger*, which, with the fibres it produces, forms the two thalami optici, that are here pretty firm ganglia, and are called *the great inferior cerebral ganglia* by Gall. The bundles, on leaving the superior part of these ganglia, reunite into fibres less diverging, and then traverse two other ganglia — the corpora striata, called by Gall *the external masses of the pulpy substance of the great superior cerebral ganglion*. Here they acquire another increase, sufficient to enable them to form the posterior lobes and all the superior convolutions of the anterior and middle lobes (Cut, p. 312.), which are always in direct proportion to the thalami.

All these fibres of the brain (Cut, p. 312.) are styled by Gall *diverging*, departing, or apparatus of formation. But those of the two sides, that are united by transverse fibres or commissures, are styled by Gall *converging* or entering fibres. The mesolobe is the great commissure of the superior convolutions of the hemispheres. The inferior convolutions of the anterior lobes are united by what was called the anterior fold of the mesolobe, — by the anterior portion of it, which was considered to bend down and thus form the anterior extremity of the lateral ventricles, afterwards

forming their floor by running on backwards, just as before bending down it had formed their ceiling. This pretended anterior fold is consequently termed by Gall *the mass of the union of the inferior convolutions of the anterior lobes.* The fornix is the commissure of the posterior convolutions of the middle and of all of the posterior lobe, and is called by Gall *the mass of the general communication of the brain.* The lyre is the assemblage of the filaments of union in the fornix. The pretended posterior fold of the mesolobe is the commissure of the posterior internal convolutions of the middle lobe. The anterior convolutions of the middle lobe, and some situated at the bottom of the *great fissure of Sylvius*, called by Gall *the great fissure between the anterior and middle lobes of the cerebrum*, give rise, by their union, to what is called *the anterior commissure of the lateral ventricles*, but by Gall *the union of the anterior convolutions of the middle lobe.* The *posterior commissure* of the lateral ventricles cannot be traced to the convolutions, but only just into the thalami optici, and is therefore named by Gall *the posterior commissure of the great inferior cerebral ganglion.* The middle commissure, for the same reason, and on account of its softness, is called by him *the soft union of the great inferior cerebral ganglion.* (Cut, p. 313. 316.) Each of these points of union is proportionate to the parts which it unites. Gall considers the origin of the converging fibres to be in the superficial pulpy substance.

The converging fibres of all these commissures, after lining the interior of the two lateral ventricles, or *great cavities of the cerebrum*, as Gall styles them, while he terms the third ventricle *the space between the great inferior cerebral ganglia*, interlace with the *diverging* fibres, and thus form a true tissue. (Cut, p. 313. No. 35, 36. 38, 39.; p. 316. No. 33, 34. 36, 37.)

The diverging fibres are then prolonged in the form of a fibrous expansion.

If the ventricles are opened, and their walls gently expanded with the hand, or if fluids collect in them, as in hydrocephalus, the tissue of diverging and converging fibres is at length lacerated. After this, the expanding force acts upon merely diverging fibres, and all the convolutions disappear; the brain becoming expanded into a smooth bag. A convolution is thus proved to be two fibrous layers, placed side by side, and very slightly united: therefore, if air or water is impelled against the centre of a

convolution cut transversely, it opens this from its base to its summit.[f]

A convolution. The centre (a) of the white substance is seen opened by the impulse of air.

Many fibres, especially those at the sides, are short; while others are longer, and this the more central they are. Hence the prolongations and depressions of the surface of the cerebrum—or, in other words, the convolutions. The parts most developed have the fewest convolutions; and, in hypertrophy of the brain, the surface is also more regular and smooth, the shorter fibres approaching in length to the longer. The convolutions are seldom quite vertical, and their white substance is thicker at their lower parts, since there both the shorter and the longer fibres exist.

All the fibres are covered by cineritious pulpy substance at their extremities.

The origin of the cerebellum is in the *corpora restiformia*, according to Gall.[g] They increase as they ascend; and, entering the cerebellum, penetrate to a mass of grey substance of a somewhat rhomboidal form and with serrated edges, whence it is styled *corpus rhomboideum* or *dentatum*. It is considered by Gall

[f] Gall, from observing the mind of hydrocephalic patients to be little or not at all impaired, was certain that Walter, Ackerman, and numerous others, were wrong, who maintained that the brain was destroyed in the disease. Finding a female, 54 years of age, with her head greatly enlarged, he entirely supported her, as he informed me, till she died, in order to prove the correctness of his opinion. He examined her brain, and was thus led to discover the true nature of the convolutions, and the operation of the distending fluid in hydrocephalus. Mr. Chenevix, Dr. Spurzheim's friend, suppresses this (*British and Foreign Quarterly*, 1830), and says that a fortunate accident occasioned the discovery (p. 10.). His article contains other instances of inaccuracy and injustice towards Gall; but received Dr. Spurzheim's sanction. By this discovery alone, Gall proved that those, who still obstinately spoke of the brain as *pulp*, were wrong. Pulp would be washed or blown away at the centre, and every where else, by the impulse of air or water, and would not separate into two regular layers. Yet I recollect that in Edinburgh, in 1809, when I was studying, his anatomy and his assertion of the fibrous structure of the brain were ridiculed as too absurd.

[g] *Anat. et Phys.*, vol. i. p. 249. sqq.

as intended to increase the formative fibres of the cerebellum, and therefore he terms it the *ganglion of the cerebellum*. (Cut, p. 311. No. 7*.; p. 312. No. 9.) One of the principal bands which proceed from this advances towards the median line, and with its fellow becomes a long rounded eminence, or ridge, rising from before backwards, and usually called *the vermiform process*, but by Gall *the fundamental part of the cerebellum*, because it is always found in animals which have a cerebellum. (Cut, p. 313. No. 8.) The other bands from the ganglion proceed upwards, downwards, backwards, and outwards, disposed in thin horizontal layers; those which are nearest the middle being the longest, and those nearest the spot where the original bundles enter the ganglia the shortest. Their extremity distant from the middle is covered with cineritious pulpy substance. A vertical cut exhibits the white layers as branches and twigs, each being surrounded by cineritious substance; the twigs so surrounded resemble leaflets; and the whole is known by the name of arbor vitæ. (Cut, p. 312, 313. 316.)

Besides these *diverging* fibres, there are, as in the cerebrum, converging fibres, having no immediate connection with the primitive bundle, with the chorda oblongata, or with the ganglion. These arise from the pulpy substance, and proceed in different directions among the diverging fibres towards the external anterior part, where those from each side, under the name of crura cerebelli, unite together and form the mesocephalon, or, more properly, the large commissure of the cerebellum. (Cut, p. 304. No. 13.; p. 311. No. 9.; p. 313. No. 27.; p. 316. *b*.) The size of this is in direct proportion to the size of the hemispheres of the cerebellum, just as the corpus restiforme, ganglion, and cerebellum, are all proportionate to each other. Another cerebellic commissure exists at the vermiform process, by means of the soft delicate layers of transverse fibres of its superior and inferior part. A layer of fibres, under the name, according to Reil, of inferior medullary veil, or commonly of valve of Vieussens and processus a cerebello ad testes, or, according to Gall, of *mass of connection between the primitive part of the cerebellum and the corpora quadrigemina*, establishes a commissure between the cerebellum and the corpora quadrigemina: and another layer, termed by Reil the superior medullary veil, establishes a commissure between the lower portion of the fundamental part or vermiform process and the posterior pyramidal bodies of the chorda oblongata. (Cut, p. 313.) The fourth ventricle is a mere space

between the chorda oblongata and the cerebellum. (Cut, p. 313. No. 8, 9, 10.) Gall terms it the space placed before the fundamental part of the cerebellum, just as he terms the third ventricle the space between the great inferior cerebral ganglions; and the lateral ventricles he styles the great cavities of the cerebrum. Dr. Macartney has lately declared that the sides of the encephalic cavities are so closely applied to each other that no cavity really exists; so that there is merely an extension of internal surface.[h]

The encephalon communicates with the rest of the body by the spinal chord and other chords termed *nerves.* These appear proceeding from its base and from the spinal chord. If we inspect the base of the brain (see Cut, p. 304.), we observe, besides the cerebrum and cerebellum with their lobes, the mesocephalon and chorda oblongata, the corpora albicantia, pons Tarini, tuber cinereum, infundibulum, and pituitary gland — the four latter of which are, like the parts in the ventricles, most absurdly named, and the five latter of which are masses of pulpy substance — eleven pairs of nerves: — the *glosso-pharyngeal,* for taste only; the *olfactory,* for smell only; *optic,* for sight only; *acoustic,* for hearing only; three conveying volition to the muscles of the eye, the *common motors, trochleare* or *pathetic* or *internal motor,* and *abducent* or *external motor;* the *lingual,* conveying volition to the muscles of the tongue; the *facial,* conveying volition to some muscles of the face; the *vagum,* or, according to Chaussier, pneumo-gastric, but correctly *pneumono-gastric*[i], — a pair of sense and motion, communicating between the lungs, larynx, trachea, and stomach, &c., and the brain; and the *trigeminum,* which also is double, and furnishes many nerves giving common sensibility to the face and head at large, and conveys the will to the muscles of the lower jaw.[k]

[h] *Report of the Third Meeting of the British Scientific Association,* p. 453.

[i] Such words, compounded of two Greek or Latin nouns, are made with the dative of the first, its last syllable being generally made to end in *o.* The genitive of *πνεύμων* is *πνεύμονος,* and the dative *πνεύμονι.* See my paper on the Medicinal Properties of Creosote, in the 19th vol. of the *Transactions of the Royal Med. and Chir. Society,* p. 11. sqq.

[k] In old language, the glosso-pharyngeal; the first; second; portio mollis of the seventh; the third, fourth or pathetic, and sixth; ninth; portio dura of the seventh; the eighth, of which the glosso-pharyngeal was considered a part; and the fifth, or mixed pair, as Gall called it from being satisfied of its mixed functions.

The olfactory, optic, and common and internal motors of the eye, arise from the cerebrum or mesocephalon; the rest from the chorda oblongata. From the chorda spinalis, thirty-one pairs of nerves, double in substance and function, like the trigeminum, proceed on each side, by an anterior and a posterior root;— eight pairs in the neck — the first above the first cervical vertebra, the last below the last cervical vertebra; twelve in the back; and five in the loins, — the last below the last lumbar vertebra. The anterior root of these double nerves is smaller than the posterior, and each begins by many filaments, which unite in their passage out. The posterior root forms a ganglion, and the nerve externally to this unites with the anterior nerve.

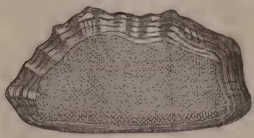
The five pairs of the lumbar portion, proceed, enclosed in membrane, together with five or six other pairs, from the bulbous extremity of the chord, and pass through the foramina of the sacrum. This splitting of the chord is termed the *chorda equina*. Besides these, a pair arises at about the seventh or eighth cervical pair, called *accessory*, running up into the cranium through the foramen magnum, and coming in contact with the pneumonogastric nerve; and it passes out again through the foramen lacerum.

Many nerves unite: for instance, twigs of the portio dura with twigs of all the branches of the trigeminum; and twigs of the ninth with the lingual branch of the trigeminum. Many nerves unite to separate again, forming what are termed *plexuses;* and the nerves running into and from a plexus may be different in number. (Cut, p. 315.) On some nerves we observe nodules of various shapes, called *ganglions;* and sometimes more than one nerve have the same ganglion. We have seen that Gall applies the word ganglion to masses of nervous substance also in the encephalon and spinal chord; and other anatomists, in a similar manner, apply it to the enlargements of the fifth cerebral nerve and of the posterior spinal nerves.

Nerves are collections of white filaments contained in delicate membranes, and united into fibres like those of the brain, and all invested with another membrane, called *neurilema*, which again is enclosed in a firm white membrane. M. Raspail has lately examined them, and finds them to be aggregations of solid cylinders, each invested, like muscular fibrils, with a fine membrane, and the whole with a common covering to form a trunk.[1] He declares that no tube exists in them, as many have asserted. A

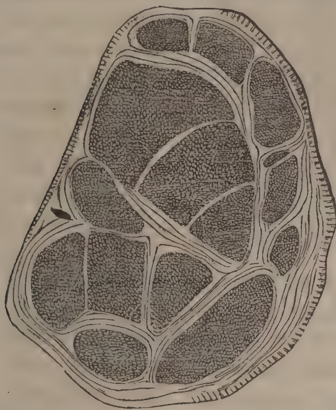
[1] *Nouveau Système*, § 513. sqq.

thin transverse section of a branch of a ganglionic nerve ex-



Slice of a branch of a ganglionic nerve, — (M. Raspail.)

hibits a single chord; but a similar section of the median of the arm exhibits several, every chord having its own membrane, as



Slice of the median nerve of the arm: the cut ends of the fibrils are seen, with the covering of every bundle, and of the whole. The single spot represents a blood-vessel. — (M. Raspail.)

well as the whole one in common; and their number is greater, the further from the head the examination is made.

A longitudinal view presented the filaments with a granulated appearance, like the orifices of tubes; but this was probably the effect of the refraction of light, and it occurred when other textures were examined in the same way. (See first cut overleaf.) Each cylinder of a human nerve is said by M. Raspail to be about ·00787 of an inch in diameter.[m]

Though the fibres are parallel, their filaments continually unite, so that a nerve appears more or less reticular.

A plexus is the same arrangement on a large scale.[n]

Ganglions consist, like the encephalon and spinal chord, and

[m] Professor Ehrenberg says that the olfactory and optic nerves, and the branches of the sympathetic, are entirely composed of granulated or knotted fibres; while nerves of motion and the regular spinal nerves are cylindrical and tubular, and continuations of knotted fibres of the brain now become cylindrical.

[n] Dr. Macartney asserts, indeed, that in all plexuses a complete mingling of the substance of all the nerves takes place, and that there no less is a mingling of the roots of the spinal nerves with the spinal chord. (l. c. p. 451.)

Longitudinal view of the fibrils of a nerve. —(M. Raspail.)

the swellings at the roots of the nerves of sense, called also ganglia, of white fibrous substance, and of a pulpy, greyish, reddish, or whitish substance in which this is plunged and from which it is easily distinguished. The white filaments anastomose and interlace or mingle most freely, and membranes exist similar to those of nerves, within them and without. M. Raspail represents a ganglion like the median nerve, only that the separate portions half enclose each other.

Slice of a ganglion of the sympathetic nerve. The nervous trunks are only half enclosed in each other, but all in a common covering. The black spots represent blood-vessels. —(M. Raspail.)

Besides the ganglia of the encephalon and of encephalic and spinal nerves at their origin, there are, on each side, several ganglia in the head;—the ophthalmic or lenticular, the spheno-palatine or Meckel's, and the cavernous, the otic, and sub-maxillary; there are three cervical; twelve dorsal; five lumbar; and five or six sacral; one at the heart, called cardiac; and two in the abdomen, called semilunar. Branches connect them with the encephalic and spinal nerves. Single branches run longitudinally between them all, connecting their whole series; and the lines unite in a single ganglion on the os coccygis. Old anatomists gave the whole the name of sympathetic or intercostal nerve, and supposed it to arise from the encephalo-spinal nerves.[o] The ganglionic nerves are less firm than the encephalo-spinal, and of a less clear white.

We must not forget that every part of the nervous system throughout the body is directly connected with others, and indirectly with all the rest, just as is every blood-vessel in regard to its system.

Nerves subdivide and soften till they are lost, with the exception of the optic, which expands into a membrane called retina, and of the coalition of nerves. The diameters of branches are said usually to exceed that of a trunk.

I have used the words *prolongations*, *arise*, &c., but merely for the purpose of ocular description; since Gall has shown that the nerves and spinal chord do not arise from the brain, but only communicate with it; nor the spinal nerves from the spinal chord: for, when the brain is absent, the fœtus may equally possess encephalic nerves and spinal chord[p]; and, when the chord is absent, the fœtus may equally possess spinal nerves; and the brain and spinal chord, and the brain and encephalic nerves, are in no proportion to each other in the various species of the animal kingdom, nor the spinal nerves to the spinal chord, nor does the latter diminish as the nerves go off.

The idea of the nerves proceeding from the brain is as unfounded as that of the arteries proceeding from the heart, or one portion of an extremity from another. Fœtuses are seen with an arterial system, and no heart; others born with no arms, but

[o] Writers say cerebro-spinal. But, if cerebrum is not allowed its classical meaning — the whole cranial nervous mass — as well as its scientific application to a portion only, the term cerebro-spinal must be replaced by encephalo-spinal.

[p] Gall, 4to. t. ii. p. 77. sqq.; 8vo. vol. i. sect. ii. For spinal nerves without chord, see *Hist. de l' Acad. des Sciences*, 1746, p. 42.

fingers at the shoulders. Independently of contrary arguments, we may demand proofs of the opinion: none are given; and it has, no doubt, been derived from the shooting of vegetables. Gall's opinion is now universal. Yet, when he wrote, he found no recent modern writer doubt that the spinal chord was a prolongation of the encephalon.[q]

When I published my last edition, Gall's anatomy was so little known, and his mode of dissecting the brain by tracing its constituent parts so disregarded, that I felt it right to express my wonder, as one of his disciples, M. Barbeguière, did thirty years ago in Berlin[r], that, while students were not instructed to dissect limbs and trunks by slices, as we cut brawn, they should be taught no other mode of examining the brain, and thus be left in ignorance of its true structure. But now his anatomical discoveries are referred to in every good book upon anatomy; and are given at full length in Dr. Cloquet's *Manuel d' Anatomie descriptive*, and the excellent *Elements of Anatomy* by Dr. Quain; and his mode of dissecting the brain is taught in all the best schools.[s]

[q] "This was the opinion of MM. Sabatier, Portal, Chaussier, Boyer, Cuvier, Fodéré, Dumas, Ackerman, Walter, &c." (*Anat. et Physiol.*, vol. i. p. 50.) just as of the ancients, and of other moderns, except Bartholin and Vieussens; of whom the former began to doubt, and the latter, indeed, expressed himself decidedly; but then in his descriptions and figures Vieussens still represented the brain as the origin of all the nerves, — an inconsistency committed by Soemmerring, who, while he regards the spinal chord as self-existent, declares it is produced by the mixture of the medulla of the cerebrum and cerebellum. Haller, Soemmerring, Blumenbach, derived the nerves from the brain and spinal chord; Prochaska, Reil, Bichat, Cuvier, even the ganglions also from the latter; and all continued to regard it as a prolongation of the encephalon. The French commissioners gave way; but Ackerman and Walter persisted! (l. c. vol. i. p. 49. sqq.

[r] *Exposition de la Doctrine de Gall sur le Cerveau et le Crâne*, par Dr. C. H. E. Bischoff; traduit de la seconde édition de l'Allemand, par G. Barbeguière. Berlin, 1806. "Is it not the height of folly to pretend to demonstrate the brain accurately by destroying it in slices?" (p. 19.)

[s] We may see in a report of Cuvier's, upon the experiments of M. Fleurens, after the fall of Napoleon, his admission of many of Gall's discoveries, which, in order to please Napoleon, who was jealous of the German, from being vexed with the honours paid by the Institute to another foreigner, — our countryman Sir Humphry Davy, he had previously doubted, or absolutely denied (having been favourable to Gall's views till he suddenly learned Napoleon's feelings) in a report presented by him and others upon Gall's anatomical discoveries to the French Institute, in 1808; — "A report," says Gall, "which will always be one of the most valuable proofs of the backward state of the anatomical and

There are great varieties in the absolute and relative amount of the several portions of the nervous system. But the brain of

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physiological knowledge of the nervous system at that time, and how much science owes me in this respect." (*Sur les Fonctions du Cerveau*, t. vi. p. 318.) Even in this report, Cuvier had been obliged to confess that "the most accredited method of the schools, and that usually recommended in books of anatomy, is to take away successive slices of the brain, and observe the appearances offered by each. This is the easiest in practice for demonstration, but it is the most difficult for the imagination. The true relation of parts, which are always seen cut across, escape not only the pupil, but the master himself." Yet, rather than give Gall the due credit of unfolding the brain from the chorda oblongata, the Committee of the Institute pretended that Varolius and Vieussens had, two centuries before, done the same thing; whereas Vieussens dissected the brain from the centrum ovale, and he is declared by the Committee to have practised the same mode of dissection that Varolius employed. Varolius, on the contrary, began his dissection at the base, yet not in order to trace the parts from the base, through the brain, but simply, he says, because the brain compressed the several organs at the base, against the skull, especially in the dead body, and rendered the ordinary mode of dissecting from above inconvenient. He had so false an idea of the anatomy of the brain, that he conceived the crura cerebri and cerebelli were shoots from the respective parts, and produced the spinal chord: while, however, he also declares the spinal chord to *be formed from the cerebrum*, between the hemispheres and the pons! In truth, our countryman, Dr. Willis, who lived a century and a half ago (*Cerebri Anatome*), was the first who objected to slicing, and dissected the brain from the base: but by base he understood the corpora striata and the thalami; and from these he both ascended and descended to the chorda oblongata. (*Rapport des Commissaires de l'Institut de France*, in Gall's *Recherches sur le Système Nerveux en général, et sur le Cerveau en particulier.*

The *Edinburgh Review*, which we shall see viewed the whole doctrines of Gall, "anatomical, physiological, and physiognomical," as a piece of thorough quackery from beginning to end, in June, 1815, did him justice, like Cuvier, lately, in a most remarkable manner, but without the generosity of mentioning his name. (No. xciv. 1828.) "Even within our own time," it now says, "although many great anatomists devoted themselves almost exclusively to dissecting the brain, this organ used to be demonstrated by the greater number of teachers in a manner which, however invariable, was assuredly not particularly useful. It was so mechanically cut down upon, as to constitute a sort of exhibition worth nothing. The teacher and the pupil were equally dissatisfied with the performance, and the former probably the most. The latter soon gave up the painful attempt to draw any kind of deduction from what he witnessed, and disposed of the difficulty as he best could, when he had to render an account of what he had seen. Up to this day, our memory is pained by the recollection of the barbarous names and regular sections of what was then the dullest part of anatomical study, which, although often repeated, left no trace but of its obscurity or absurdity. Here an oval space of

an adult, probably between 20 and 60 years of age[t], is said to weigh, on the average, between 40 and 50 ounces; the

white colour, and there a line of grey, or one of red, were displayed: here a cineritious, there a medullary, mass: here a fraction white without, grey within; there a fraction white within, and grey without: here a gland pituitary, there a gland like grains of sand: here a ventricle, and there a cul de sac with endless fibres, and lines, and globules, and simple marks with appellations no less fanciful than devoid of meaning." These are just Gall's views, for which he was loaded with opprobrium. *Anat. et Physiol.*, vol. i. p. 287. sq. 285.

Loder, who not only had attended Gall's lectures at Halle, but dissected nine human and thirteen brute brains with him, adds, after specifying Gall's anatomical discoveries, "These discoveries alone would be sufficient to immortalise Gall's name: they are the most important which have been made in anatomy since the discovery of the absorbents. The discovery of the unfolding of the brain is admirable." "I am ashamed and indignant with myself for having, with others, been slicing hundreds of brains, like cheese: *I* never perceived the forest for the multitude of the trees." "I say, with Reil, that I have found more than I thought one man could discover in the course of his life." *

"Reil," said Professor Bischoff, above thirty years ago, "who, as a profound anatomist and judicious physiologist, requires not my praise, rising superior to all the littleness of vanity, has declared that he found more in Gall's dissections of the brain than he thought *any* man could have discovered in *his* whole life." *Exposition*, just quoted, p. xxvi.

Such is the judgment of Reil on what Mr. Mayo calls Gall's "popular and showy anatomy," dependent for its correctness, when it is correct, "rather to bold and fortunate conjecture, than to cautious and philosophical research;" amounting to "little more than an expansion of the views of Willis," and destitute of the force of "demonstration which belongs to the researches of" Reil — their "rival." Gall, so far from regarding Reil as a rival, thus speaks of him: — "With what readiness would the nervous system, this noble part of anatomy and physiology, the knowledge of which has so long made such small progress, have been restored to its dignity, if, in every country, men like Reil, animated with the love of truth, and endowed with a spirit of profound observation, had followed his example! We are proud that the discoveries made by this able naturalist in the cerebellum, by following a totally different course from ours, agree so perfectly with ours." (*Anat. et Physiol.*, p. 250.) In truth, Gall was too good towards Reil; for, after Gall's report to the French Institute, Reil,

[t] Dr. Sims has just published, in the 19th vol. of the *Trans. of the Royal Med.-Chir. Society*, the most extensive averages of the weight of the brain. His average weight of the adult brain, between 20 and 60 years of age, is from rather above 44 to rather above 46 ounces.

* Bischoff, l. c. p. xxix. Also Gall, 4to. vol. iv. p. 378. sqq.; 8vo. t. vi. p. 493. In this sixth volume will be found copious answers to Tiedemann, Rudolphi, Serres, &c., and a refutation of many of their anatomical assertions.

spinal chord about an ounce and a half; and the corresponding nerves, could they be collected to their minutest ramification,

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from whom Gall was said by Dr. Gordon and Mr. Mayo to have borrowed, but from whom he could have learned nothing, because Reil had not published at the time of Gall's discoveries, promulgated, in his *Archives*, views similar to those of Gall, without, indeed, claiming them as his own, but without ascribing them to Gall or any one. He also gave the parts different names — such as wings, mountains, teeth, lobules — agreeable to none but mechanical dissectors, who, like Dr. Gordon, as Dr. Spurzheim remarks, consider the anatomy of the brain unnecessary to physiological and pathological views.

Gall demonstrated the Brain to Reil, in the summer of 1805, privately, and so much pleased him that he gave Gall some of his drawings. (*Examination of the Objections made in Great Britain, &c.*, by Dr. Spurzheim. Lond. 1817.) Dr. Spurzheim here says, that Gall and he demonstrated. But he had been engaged by Gall only some months before as his assistant and dissector; and Reil's presents in return were, he confesses, all to Gall. Reil calls them *Gall*'s demonstrations, and wonders at such discoveries being made by *one* man. A medal had been already struck to Gall at Berlin (*Bischoff*, p. xvi.); all the attacks for both the Anatomy and Physiology were made upon Gall; and all the accounts of the anatomy and physiology published by his pupils were given as of his discoveries, without the mention of Dr. Spurzheim's name, except once, when he is thus spoken of as Gall's assistant at lecture: — "Gall unfolded the convolutions without any difficulty by means of the fingers of the director Spurzheim." (*Cranologie, ou Découvertes nouvelles du Docteur F. J. Gall, concernant le Cerveau, le Crâne, et les Organes;* ouvrage traduit de l'Allemand. Paris, 1807, p. 32., the original having appeared at Dresden in 1805.) We learn from this, which, curiously enough, is the only notice of Dr. Spurzheim in the early history of Phrenology, how Gall and *he* demonstrated! "While at Vienna, *we* spoke of the great leading points of our anatomical demonstration." "In 1805, at Berlin, *we* repeated our anatomical demonstration." "Outlines of *our* anatomical and physiological propositions were published during that spring by Professor Bischoff." This is the work already quoted. Now, Bischoff speaks of them solely as Gall's, and does not once mention Dr. Spurzheim's name. "At Dresden, M. Bloede published outlines of *our* anatomical and physiological views." I have read Bloede, in the work just referred to, and translated at Paris under the title of *Cranologie*, — a part of which is called *Découvertes Anatomiques du Docteur Gall, d'après l'Exposition du Docteur Bloede*, — and find only Gall mentioned, except in the quotation just made, where he is said to have used the fingers of his managing man Spurzheim to unfold the convolutions. The accuracy of Bloede's work is vouched for on the ground of its being approved of by "the discoverer Gall." (p. xv.) Dr. Spurzheim then goes on to say that Gall and he continued to lecture and demonstrate the brain in Weimar, Jena, Gottingen, Brunswick, Hamburgh, Keil, Copenhagen. Now, he never gave a lecture; and only obeyed Gall's orders mechanically in silence, while Gall was demonstrating. Dr. Spurzheim never then pretended to discoveries; and yet all the great discoveries were already made. Gall assured me that the discoveries, both anatomical and

would weigh several ounces. The ganglions and ganglionic nerves can weigh but little comparatively. Dr. Macartney de-

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physiological, made after he engaged Dr. Spurzheim as his assistant, were merely slight modifications, — *des nuances* were the words he used; and the truth of this is evident to those acquainted with the early literature of the new anatomy and physiology of the brain. Dr. Spurzheim himself affords, in many parts, refutations of his unjust and absurd attempts to arrogate what is not his due. For instance, he says (*Anatomy of the Brain*, p. 148.), "Modern anatomists before Gall and *myself* were divided in opinion on the subject of the decussation." Yet, at p. xi. he says that, having completed his studies in 1804, he was associated with Gall, "and at this period Dr. Gall, in the *Anatomy*, spoke of the *decussation* of the pyramidal bodies; of their passage through the pons Varolii, of eleven layers of *longitudinal* and *transverse fibres* in the pons, &c."!! Yet at p. 5. Dr. Spurzheim says the opinion that the white substance was fibrous is, that "which Dr. Gall and *I* have espoused." An instance of his short-sighted ambition is afforded at p. 95. of his *Anatomy*, where he positively says, "Before Dr. Gall and *I* began our researches, all other anatomists were in the habit of cutting down the brain by slices," &c.; whereas, before Gall ever saw him, Gall had taught his new method to thousands: Gall taught it to him among the rest, and engaged him as his prosector. At p. 178., he says, "Until Dr. Gall and *I* published, it was the custom to take merely mechanical views of these" (the commissures); whereas, in Bloede and Bischoff it appears that Gall taught all the true views of them before he saw Dr. Spurzheim. At p. 110. he says,—"Dr. Gall and *I* claim the merit of having been the first to compare the relations between the development of different cerebral parts and peculiar functions." When every where, even in the first volume of the 4to. work, to which Gall, in the kindness of his heart, affixed Dr. Spurzheim's name with his own, in order, as he often said, to encourage him, and because he thought that Dr. Spurzheim would carry on phrenology after his death as he himself had done, Dr. Spurzheim, like all the world, acknowledges Gall to have been the first discoverer of the functions of different parts of the brain, and of course through observing development. At p. 115. he claims this all for himself! though at p. xvi, of the preface to Gall's 4to. work, with his name added by Gall, this is all given to Gall. "*I* claim the merit of having been the first to maintain that the analogy or differences of cerebral parts in different classes ought to be determined by the combined aid of Anatomy and Physiology!!" Dr. Spurzheim gives another striking refutation of his own assumption. Gall had made and promulgated his discoveries, when Dr. Spurzheim, as he himself admits, *having finished his studies in* 1804, joined Gall. (*Anatomy of the Brain.* London, 1826. p. xi.) Yet, in his eagerness to be equal with Gall, he unluckily writes, in his *Examination, &c.*, "I beg to observe that, in the summer of 1805, *we* demonstrated to Reil the same leading points in the anatomy of the brain which we still maintain!" He whose fingers only were employed on the occasion! he who had joined Gall but a few months from the class room! In truth, the new anatomy of the brain did not consist in this little detail of discovery, or that, but in grand general views of structure; and this

clares he has ascertained the real nervous substance to be so inconsiderable, that he thinks " it is, perhaps, not assuming too much

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was entirely Gall's, and completed before Dr. Spurzheim knew any thing of the matter. Possibly Dr. Spurzheim occasionally made a few little mechanical discoveries, like the person who was Gall's previous dissector, a M. Niklas; of whom Gall says in his preface (4to. vol. i. p. xvi.), " I taught M. Niklas my method of dissecting the brain; and, thanks to his industry and address, he made such progress that he directed my attention to many mechanical points till then unknown." But Dr. Spurzheim, like him, worked under Gall: was ordered to dissect this and that, and to ascertain what was the fact on this point or on that: and the shades of discovery, as Gall terms them, made after he was engaged by Gall, must evidently be ascribed to the working master-mind, and not to the fingers of him who only obeyed, and received his knowledge all but perfect at first, and was *very long* before he could be taught by Gall to dissect a brain decently according to Gall's method. Gall told me that he taught Dr. Fossati in a quarter of the time it cost him to teach Dr. Spurzheim. Because M. Niklas worked and discovered mechanically, Dr. Spurzheim declares (*Notes, &c.*, p. 61.) that the investigations directed by Gall had merely mechanical views, and, referring to the last quotation for his proof, he insinuates that Gall's investigations were too mechanical; whereas, Gall's merit was in rejecting all mechanical views. Dr. Spurzheim's character is put by himself in the strongest light in the *Notes* (p. 60. sq.), by his quoting with triumph a passage from Gall, in which are the words, "beaucoup de personnes manifestent une tendence singulière d'attribuer NOS découvertes à d'autres, par exemple, à Reil; et M. Spurzheim a déjà dans plusieurs endroits revendiqué NOTRE propriété." Now, Dr. Spurzheim knew that Gall used the plural, according to the habit of authors, for the singular: because, immediately before this passage, in the large edition, Gall says, — " *I* have repeated, and ordered to be repeated, hundreds of times, the researches upon the brain. Sometimes *we* thought we had discovered something new; but, by repeating the dissections, *we* have always come back to *our* old ideas. Therefore *I* have no reason to modify what *I* said in the first volume of this work." He then, in both editions, in order, he says, to set those right who ignorantly attribute the discoveries to others, subjoins to this passage the declarations already quoted, of Reil and Loder, respecting *his* anatomical discoveries, which they ascribe to *Gall alone;* and finishes with a summary of all the anatomical and physiological discoveries, speaking of them as *his own* entirely. (Gall, 4to. vol. iv. p. 377. sq.; 8vo. t. vi. p. 490.) In the volume and a half to which Gall affixed Dr. Spurzheim's name with his own, he always wrote in the plural; in the rest, he from the first wrote generally in the singular; and he refers in the singular to what he had said in the first volume in the plural. (See l. c. p. 378. *supra;* and vol. ii. p. 213.) I give another striking instance of Dr. Spurzheim's self-refutation, and the shortsightedness for which he was remarked in Paris when under the influence of his inordinate love of fame. Gall kindly affixed Dr. Spurzheim's name with his own, not only to his great work, but also to the memoir presented to the French Institute. Yet Dr. Spurzheim acknowledges that the Commissioners received the discoveries as Gall's; for, in order to show that Reil must have known the

to suppose that the whole nervous system, if sufficiently expanded, would be found too tender to give any resistance to the touch,

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discoveries before writing, he quotes, in his *Notes* to the *Foreign Quarterly* (p. 59.), the following words, with which they opened their report: — "The anatomical doctrine of *Gall*, through the delivery of lectures by *him* in the chief cities of Europe, and the numerous extracts published by *his* pupils, have become nearly as well known as though they had appeared in an authentic impression." In these *Notes* he says that he settled his anatomical account with Gall in 1820, and that Gall never answered this and other claims. Gall certainly never would have condescended so far. Indeed, Gall was perfectly ignorant of the greater part that Dr. Spurzheim wrote. After reading some of Dr. Spurzheim's first English work, published on his arrival in England, Gall gave the book with disgust, but half cut, to Dr. Fossati, and knew nothing more of Dr. Spurzheim's sayings and writings afterwards than what was pointed out to him; and it was with the greatest difficulty that he could be prevailed upon to take any notice, even for a moment, of what was pointed out to him. My friends Dr. Fossati and Dr. Dancey, who were constantly with Gall, assure me of this, and are astonished at Dr. Spurzheim. Indeed, Gall, in the preface to his third 4to. volume, which contains all the anatomy, had, in 1818, given an answer to all Dr. S.'s anatomical claims. He shews that Dr. S. had no more to do with the volume than to furnish the references. (p. xvii.) At the end of his 8vo. work, Gall also disposes of these claims by summing up the anatomical discoveries as his own. In the American edition of his *Phrenology* (vol. i. p. 12.) Dr. S. grows so ambitious that he no longer shares with Gall, but at once boldly asserts, "all anatomical discoveries made after 1804 are the result of my labours; and in his *Anatomy* (p. xiv.), he madly says, as to Gall's 4to. volume, "My discoveries form its principal object"!!!

When Gall was entreated to do himself justice with Dr. Spurzheim, he always mildly answered, that enough had been published of his discoveries before Dr. Spurzheim's time for posterity to see Dr. Spurzheim's folly; and that all the world knew the great quarto work to be his, though he had been silly enough to join Dr. Spurzheim's name with his own. I fear that Dr. Spurzheim relied on Gall's dignified pride for escaping his deserts.

Yet among those who never saw Gall, and who have derived their knowledge second-hand from Dr. Spurzheim's works, and read slightly, or not at all, the works of Gall, and especially those who, in addition to these disadvantages, mixed much with Dr. Spurzheim, his pretensions are allowed. In France he was nothing; his lectures little attended, while Gall's were crowded; and he neglected, while Gall had high practice and the highest consideration. But Gall's works have not been translated, while Dr. Spurzheim published again and again in English, and spent much of his time in Great Britain, and died in America. The result here and in America cannot be better shown than first, in the following ridiculous passage from "an anatomical report on the skull of Dr. Spurzheim, read before the Boston Phrenological Society, by Dr. N. B. Shurtleff, and printed in the *Boston Annals of Phrenology*: — "Having been appointed a com-

too transparent to be seen, and probably would entirely escape the cognizance of all our senses."[u]

The nervous system is invested with peculiar coverings.

" Besides the bony cranium, a threefold covering is afforded to the brain[x], viz. the *dura* and *pia mater*, and, between these two, the *tunica arachnoidea*. These coverings are termed *meninges*.

" The *dura mater*[y] " belongs to the class of fibrous membranes, and " lines the inside of the cranium, like a periosteum, forming various processes. By the falx it divides the hemispheres of the cerebrum and cerebellum[z]; by the tentorium[a] it supports the

mittee on the skull of our lamented friend Spurzheim, the anatomist, who, by dissecting the brain, first displayed to the eye its fibrous and ganglionary structure, and demonstrated the direction and connection of its filaments," &c.! But the case is much worse, when I mention that this piece of folly and ignorance is published in the last Number of the *Edinburgh Phrenological Journal* (June 1. 1836) without any remark. When I arrive at the subject of Phrenology, I shall resume this task of doing justice to Gall.

[u] l. c. p. 450. sq.

[x] " Eustachius, tab. xvii. xviii.

Haller, *Icones, Anat.*, fasc. vi. tab. i. ii. iii.

Santorini, tab. posth. ii. iii.

F. B. Osiander, in the *Comment. Soc. Reg. Scient. Gotting.*, vol. xvi. p. 105. tab. i. ii.

Detm. W. Soemmerring, *De oculor. sect. horizontali*, tab. i."

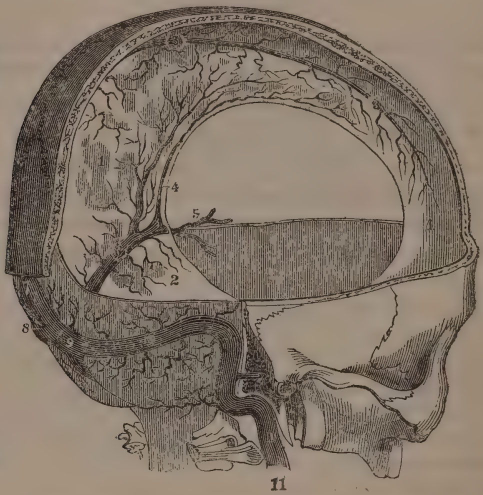
[y] " J. Ladmiral, *Icones duræ matris in concava et convexa superficie visæ.* Amst. 1738. fasc. i. ii. 4to."

[z] Sir Anthony Carlisle, on opening a woman who had died after amputation of a foot, found no falx. The cerebrum was not divided into hemispheres. The edge of the longitudinal sinus was received into a depression, about half an inch deep, that existed along the middle of the superior part of the cerebrum. The head had been unaffected, and the mental faculties perfect, as far as observation was made during the woman's stay in the Westminster Hospital. (*Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge*, vol. i. p. 212. sqq.)

I presented to the London Phrenological Society, the cast of the head of a male idiot, aged eighteen years, that was given me by Dr. Formby, of Liverpool, and is only 16 inches in circumference, and $7\frac{3}{4}$ inches from ear to ear over the vertex. The cerebrum weighed but 1 lb. $7\frac{1}{2}$ oz. The hemispheres were united as far back as the vertex, and no falx existed except for about two inches from the anterior part of the tentorium.

[a] " In the skulls of some genera of mammalia, a remarkable lamina of bone penetrates a duplicature of the tentorium and supports it. Cheselden (*Anat. of the Bones*, c. 8.) supposes this bony tentorium to exist in *feræ* only; but it is found in the equine genus, the cercopithecus paniscus, the delphinus phocæna,

posterior lobes of the cerebrum, and prevents their pressure upon the subjacent cerebellum.



1. Falx. 2. Tentorium. 3, 3. Superior longitudinal sinus. 4. Inferior longitudinal sinus, and, 5. Venæ Galeni; both opening into, 6. The straight sinus. 7. Posterior extremity of the superior longitudinal sinus. 8. A small portion of the left lateral sinus. 9. The confluence of the sinuses, or Torcular Herophili. 10. Right lateral sinus. 11. Internal jugular vein.

"In its various duplicatures it contains and supports the venous sinuses [b]," which receive blood from the veins of the brain, and convey it to the internal jugular vein, "and it prevents their pressure." It is prolonged in a tubular form throughout the canal of the spine, and has openings for the various encephalo-spinal nerves, and is prolonged a very short distance around the greater part.

"Next to the durea mater lies the *arachnoid*, so named from its thinness." It is a serous membrane, "destitute of blood-vessels, and extended, like the dura mater, merely over the substance of

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orycteropus capensis, &c. Its use is uncertain: that which is generally ascribed to it (for instance, by Laur. Nihell, *De Cerebro*. Edin. 1780. p. 4.), — of protecting the cerebellum in those mammalia which leap very swiftly — is improbable, because we find it in the bear and other animals of still slower motion, and not in the ibex which moves with the greatest rapidity."

b "Vieussens, *Neurograph. universal.*, tab. xvii. fig. 1.

Duverney, *Œuvres anatom.*, vol. i. tab. iv.

Haller, *Icones Anat.*, fasc. i. tab. vi.

Walter, *De morbis peritonæi et apoplexia*. Berol. 1785. 4to. tab. iii. iv.

Vicq d'Azyr, *Planches Anatomiques*, xxxii. et xxxv."

the brain, without following the course of its furrows and prominences;" but it enters the third ventricle by an oval opening, discovered by Bichat in the base of the telum choridianum, surrounded by the venæ Galeni, and leading from a canal called arachnoidean between the corpora quadrigemina and pineal gland, and it lines the third and afterwards the two lateral and fourth ventricles. It is a close sac, thus affording, as the peritonæum does to the abdominal viscera, a double covering to the whole brain and spinal chord, and to the nerves before their departure through the foramina of the *dura mater*, and lining the four ventricles; insulating the organs on which it lies, and affording them great facility of movement; and liable to all the morbid affections of serous membranes.[c]

Between the pia mater and arachnoid of both the brain and spinal chord, Dr. Magendie says he has discovered the existence during life, of a large quantity of clear and colourless fluid, passing from the surface of one organ to that of the other.[d] Cotugno[e] had long ago asserted its existence in the cranial and spinal cavities, after death, and its free communication, and accurately described its qualities; but, notwithstanding he gave excellent reasons for believing its existence during life, he imagined the space around the spinal chord, observed by him to be larger in the emaciated and old, and the space which in these two descriptions of subjects he found also around the brain, to be filled with an aqueous vapour; he also believed its occasional mixture with the fluid of the ventricles. Many deny at present that more than vapour exists during life and health in any serous membrane. But I certainly saw, as I formerly mentioned, a large quantity of clear fluid pass from the spinal canal the instant that Dr. Magendie opened it, in one of his barbarous experiments, which, I am ashamed to say, I witnessed, and in which he began by coolly cutting out a large round piece from the back of a beautiful little puppy, as he would from an apple dumpling. Dr. Magendie thinks he has proved the communication, not only of the fluids of the spinal with that of the cranial cavity, but also of these with that of the ventricles, by an opening at the point of the calamus scriptorius of the fourth.[f] He conceives it to move from one

[c] Bichat, *Traité des Membranes*.

[d] *Journal de Physiologie*, t. v.

[e] *Dissertatio de Ischiade Nervosa*. Published in Sandefort's *Thesaurus*.

[f] *Journal de Physiologie*, t. vii. p. 21.

part to another, as they are severally compressed by sanguineous turgescence during muscular efforts. He says he never observed the fluid escape at the spot near the venæ Galeni. There is no doubt that he did not, nor by any other: for large serous accumulations often exist in the head, and none in the spine. Most persons have no doubt that the fluid is usually contained, not between the arachnoid and pia mater, but in the serous membrane—the arachnoid. Because, 1st, the true anatomy of the parts shows that the old opinion is wrong,—shows that the arachnoid is a sac like all other serous membranes, and covers the brain and lines the dura mater; that the ventricles are lined not with pia mater, but with the arachnoid, under which the pia mater exists only as subserous cellular membrane; and that hydrocephalus is analogous with dropsies of the pericardium, pleura, peritonæum, and tunica vaginalis. 2dly, If the fluid was in the pia mater, it would be under the arachnoid, and the arachnoid, whether of the surface or of the ventricles, would be raised in proportion to its quantity, so that we should find a membrane upon the surface of the fluid both in the interior and exterior of the brain. This is not the case in common; and where it is, as in a case described by Dr. Magendie and one by Dr. W. Heberden, presently to be quoted, the close portion of the arachnoid lies conspicuously upon the fluid.[g] I am therefore satisfied that Dr. Magendie's account is wrong, and that what he calls pia mater in the ventricles is the arachnoid.[h]

Dr. Magendie found the removal of the fluid to occasion immediate dulness and immobility; but says that these disappeared as soon as the fluid was replaced, and that its secretion took place very rapidly. He believes that two ounces may exist in the ventricles without disturbance, but that a larger quantity, whether secreted

[g] I may mention that in a child I saw with hydro-rachitis the aqueous tumour in the loins disappeared, and the head immediately enlarged with hydrocephalus. This looked like any thing but communication.

[h] He appears to me ignorant of the true anatomy of these membranes, and to confound the two, as was the case of old, till the Anatomical Society of Amsterdam confirmed, in 1665, the doubts which were arising on the subject, and Van Horne demonstrated both membranes distinctly to his pupils.

Ackerman contended that fluid always exists in the ventricles, and for the purpose of maintaining a degree of pressure necessary to the functions of the brain; an increase or diminution of it arresting the cerebral functions. Sir E. Home repeated the same opinions in the *Ph. Trans.* 1814, part ii. See Dr. Spurzheim, *Phrenol.*, Amer. ed. p. 45. sq.

or injected, for example, into the spinal cavity, causes more or less apoplexy and palsy. Much must, however, depend upon the quickness of the accumulation, as the powers of accommodation are very great in living systems, and if the bones expand, very many pints may exist without impediment to the functions of the brain. Dr. W. Heberden knew a man who had been long deaf only, with the exception of vertigo and a temporary attack of confusion, and who suddenly died; when not less than eight ounces of fluid was found in the ventricles, and four on the brain under the arachnoid.[i] Morgagni gives a similar case.[k] Still these might have been instances of rapid effusion.

The blood-vessels of the brain are the two internal carotids and the two vertebrals. They are twice bent at their entrance into the cranium, to lessen the force of the blood; for not only is the organ delicate, but its arteries are thinner and weaker than others of the same size. In some brutes the internal carotid splits, for the same purpose, into a network of vessels, called rete mirabile, which re-unite into a trunk. The veins of the brain pour their blood obliquely into strong, winding sinuses, which transmit it to the internal jugulars (Cut, p. 336.); and the possibility of its reflux into the cerebral veins is thus lessened. The cerebral arteries are said by Béclard to have no third, external coat.

The pulpy substance has an immense number of blood vessels; the fibrous, a smaller number. M. Raspail exhibits one blood-vessel in the membranous investment of the median nerve, and many in the coverings and septa of the ganglion of the sympathetic, but none appeared to enter into the fibres. (Cut 2, p. 326.)

"The membrane, called *pia mater* by the ancients," corresponds with cellular membrane, "closely follows the cortical substance of the brain[l], and possesses innumerable blood-vessels which penetrate into the latter. Hence, if a portion of this membrane is detached, we find the external surface very smooth, while the internal is villous and resembles the roots of moss."[m]. It penetrates into the lateral ventricles at the semicircular fissure which exists on each side between the corpus fimbriatum of the fornix and thalamus opticus; and into the third ventricle, at the central fissure which exists between the posterior extremity of the meso-

[i] *Trans. of the Coll. of Phy.*, vol. v. [k] *Ep. Anat.*, 4. 35.

[l] "Ruysch, *Respons. ad ep. problemat. nonam.* Amst. 1670. tab. x."

[m] "B. S. Albinus, *Annot. Acad.* l. i. tab. ii. fig. 1—5."

lobe and the upper surface of the mesocephalon. These three fissures, united, and establishing a communication between the external and internal parts of the brain, were named the *great cerebral fissure* by Bichat. It runs over the third ventricle, forming with the arachnoid what is called the *velum interpositum* or *telum choridianum;* and the sides of this portion, extended and filled with a plexus of vessels, form with them, in each lateral ventricle, what is called the *plexus choroides,* also, of course, covered by the arachnoid.

The pia mater invests the spinal chord equally with the encephalon, but is there paler and firmer. It also invests all the nerves, and not only their chords and fibres, but their individual fibrils and filaments.

Dr. Macartney finds the pia mater to consist of two portions, one of which is exceedingly subtle and pervades the whole encephalic mass, acting as a framework for the nervous substance. Its delicacy allows the external portion to be readily separated from it on the surface; and it forms, he says, so large a portion of the mass, that the amount of nervous substance, as was remarked above, is very small.[n]

If from deficiency of cranium the brain is seen, it is observed to experience two motions — the one correspondent with the impulse of blood into the arteries, the other correspondent with the distension of the veins by expiration. It slightly pulsates at the stroke of the left ventricle; rising during expiration, and sinking again during inspiration; and it sinks in proportion as inspiration is desisted from the longer.[o]

It is found also in such cases to be more distended during the waking state than during sleep[p]: — a circumstance showing that

[n] *Report of the Third Meeting of the Brit. Scient. Assoc.*, p. 454.

[o] "T. Dan. Schlichting first accurately described this striking phenomenon. *Commerc. litter. Noric.* 1744. p. 409. sq., and more largely, *Mém. présentées à l'Acad. des Sc. de Paris,* t. i. p. 113.

Haller sagaciously discovered the cause of it by numerous dissections of living animals. J. Dit. Walstorf, his pupil, *Experimenta circa motum cerebri, cerebelli,* &c. Gotting. 1753.

Consult also, after F. de la Mure's works, Lorry's dissertations on the same point, *Mém. présentées,* t. iii. p. 277. sq. 344. sq.

Also Portal on a similar motion observable in the spinal chord, *Mém. sur la Nature de plusieurs Maladies,* t. ii. p. 81."

[p] "I once enjoyed an opportunity of very distinctly observing this motion, and making some experiments with respect to it, in a young man eighteen years old.

in active states of the organs they have more blood. Indeed, during strong feelings and intellectual efforts, the brain, in cases of deficiency of bone, has been seen to enlarge, experiencing a turgescence which is common to all organs during their excitement.[q] In emotions, even that of grief, the head not only aches and feels tight, but burns: hard study for many hours has the same effect. The functions of the nervous system, like those of all other organs, require a copious supply of arterial blood; and no solid can perform its living functions but by means of a fluid supplied to it.

Gall considers the pulpy substance of the nervous system as the matrix or producer of the fibrous. It is so copiously supplied with blood vessels, that Ruysch, Schallhamner, Leuwenhoek, Valisneri, Vieussens, Schwendenborg, and almost all the contemporaries of Haller, pronounced it a tissue of fine vessels; and Walter and Ackerman merely a prolongation of finer and finer blood-vessels,— an opinion that Boyer thought probable. Albinus and Sömmerring, however, showed by injection that a soft substance existed as well as the blood vessels.[r] Now, Gall argues, 1. That all parts of living bodies, as is now universally allowed, are gradually and successively developed — that their form and substance, as well as size, totally change from their origin to their perfection — not, as too many had absurdly asserted when he wrote, that all parts pre-existed of inappreciably minute size; and he asks, how the head of the snail reproduced after decapitation, how the transformation of stamina to petals, a work-

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Five years before, he had fallen from an eminence and fractured the frontal bone on the left side of the coronal suture, since which time there had been an immense hiatus, covered by merely a soft cicatrix and the common integuments. The hiatus formed a hollow, very deep during sleep, less so when he was awake; and varying according to the state of respiration, *i. e.* very deep if he retained his breath; much more shallow, and even converted into a swelling, by a long-continued expiration. At the bottom of the hollow, I observed a pulsation synchronous with the pulsation of the arterial system, such as deceived Petrioli, Vandelli, and others, at one time the adversaries of Haller, who all foolishly confounded it with that other remarkable motion which depends upon respiration.— I may add, that this wound on the *left* side of the head had rendered the *right* arm and leg paralytic."

[q] In one such case, during the excitement of one set of organs, the collapse of others was sufficient to produce a depression: and the anger of the person could always be known by merely "the holes which would appear in his head" on the coronal surface, where the bone was defective.— Ed. *Phren. Journal*, Sept. 1835.

[r] Gall, l. c. 4to. vol. i. p. 235.

ing to a queen bee, by modifications of external circumstances, are consistent with the original existence of every part. Thus, as it is clear that one part may produce another which did not exist, that the fibrous portion of the brain may proceed from the pulpy. 2. As all the fibres of nerves are seen to begin in pulpy substance, and, the greater the mass of grey substance, the greater number of fibres are seen to proceed from it; and as, whenever in the brain or spinal chord an enlargement occurs in the fibrous band, there is an accumulation of pulpy matter, that the pulpy appears destined for the production and support of the fibrous[s]; and this not only in regard to nerves, but to the encephalon and spinal chord. For, whenever a portion of the fibrous part of the brain increases, a quantity of pulpy substance is found at the point of increase; just as wherever a branch springs in a tree, its origin is in a mass of soft substance, so that the diameter of all the branches exceeds that of the stem, and they are not divisions of it. Again, before fibres appear at all, the brain and other nervous parts are altogether pulpy and greyish. For, though Dr. Tiedemann asserts that the pulpy substance of the spinal chord is not formed before the fibrous, Gall refutes him in the most masterly manner, showing that he allows the chord to be at first fluid, then "soft, reddish, and sprinkled with numerous small vessels," and that at length, in the course of the first two months, or about the beginning of the fourth month, fibres are seen. These are Tiedemann's own words; and yet he fancies he opposes Gall, who contends for the very same thing, saying, "it is the pulpy, gelatinous, non-fibrous substance sprinkled with innumerable blood-vessels, secreted the first by the pia mater, which engenders, nourishes, and multiplies the nervous fibres." Dr. Tiedemann also objects that, if the swellings or ganglions of the chord were found first to engender the rest, and the nerves corresponding with them, they should be found in the embryo; but that they are not. Certainly this cannot be expected, replies Gall, before the chord becomes consistent, or the period for the production of nerves has arrived; and when the great nerves of the extremities begin to form, and not before, can we expect that the pulpy substance which produces them will be observed.[t] Dr. Tiede-

[s] l. c. 4to. vol. i. p. 44. and p. 242.

[t] See Gall, l. c. 8vo. t. vi. p. 65. sqq. A masterly refutation, but apparently unknown to English anatomists.

Dr. Bellingeri fancies that the pulpy substance is for sensation, the fibrous or motion. I think it is Dr. Foville who fancies that the pulpy is for the pecu-

mann actually says, "Gall is right in asserting that in the adult the parts of the chord most supplied with cortical substance are those where the largest nerves are given off."[u] He allows that nervous fibres go off wherever there are ganglions; that whenever a nerve joins a ganglion, it is reinforced; and that all nerves are accompanied by more or less of this substance, through which they acquire a successive increase, so as to become conical; and that the soft substance is, at the ninth month, more abundant where nerves arise, and still more abundant at the origin of the great nerves of the extremities. Dr. Bellingeri allows the fact of the pulpy far exceeding the fibrous in childhood[x]; and Mr. Mayo allows that the origin of a nerve is always in part from fine grey matter, and that the ascending fibres of the chorda oblongata receive additions from the internal masses of grey matter, "as from new organs."[y]

Old anatomists were perfectly ignorant of the uses of the various parts which they viewed so mechanically, and distinguished by such a collection of strange names. Gall views some of them as organs of increase, others as organs of union, and others as the bands of fibres which execute the nervous functions. What are considered the parts of increase, and what of union, must appear from the descriptions given.

Just as the extreme parts of nerves execute their chief function, as seen in the case of sight, smell, taste, hearing, touch; so, probably, the extreme portions of the fibrous substance of the brain execute its functions. This opinion is rendered the more probable from the pains which I showed nature to have taken to increase the surface of the cerebrum and cerebellum, so that the fibrous substance may ultimately be spread out amidst the pulpy to an immense extent.

The substance of the brain is said to be different from that of all other animal textures. Vauquelin, in 1812, found, in 100 parts,

Water - - -	80·00	Phosphorus - -	1·50
Albumen - -	7·00	Muriate of soda, and phosphate of lime, potass, and magnesia, with sulphur	5·15
White fatty matter -	4·53		
Red ditto - -	0·70		
Osmazome - -	1·12		

liar nervous functions. But Dr. Marshall long ago gave strong reasons for ascribing them to the fibrous. (l. c. p. 239. sqq.)

[u] *Anatomie du Cerveau,* traduit par M. Jourdain, p. 135.

[x] *De Medulla Spinali Nervisque,* S. ii. c. vi.

[y] *Outlines of Physiology,* p. 241. 253. London, ed. 3.

M. Couerbe discovered a large quantity of cholesterine in the brain; and asserts that in the brain of sound persons as much as 2 or 2½ per cent. of phosphorus exists, but about half as much in the brain of idiots, and nearly double in the brain of maniacs! M. John finds firmer albumen and more fat in the fibrous than in the pulpy substance.[z] The oblong and spinal chords, according to Vauquelin, contain more fat, and less albumen, osmazome, and water: the nerves much less fat, much more albumen, and more fat analogous to adipocire. M. Raspail remarks that the investments of the nervous fibrils, chords, and trunks, explain the predominance of albumen. He also reminds us that a nervous dries to a horny substance without putrefying, whereas the brain putrefies in twenty-four hours.

Where *feeling* occurs in matter, mind exists. But the capability of feeling would be useless, were not *volition* united with it. Feeling might exist without will, but could lead to nothing: and means neither of obtaining or protracting pleasant sensations, nor of escaping from painful ones, could be adopted. Volition could not exist without feeling; for we will through motives only. Neither can the existence of feeling be known, but by the certain effects of volition sensible to others. Now feeling may be excited by external things, or by changes within. In the former case, some Scotch metaphysicians term it sensation, and, if an idea of the external thing is also excited, perception: in the latter case, they term it consciousness. When we smell, we have a sensation; when we see an object, we have a perception; when we have a wish, or an idea, or an internal pain, we are conscious. But sensation and consciousness are the same, except as to their immediate causes. Before will is exerted, on the occurrence of feeling, a wish must also be felt — a desire to escape from the feeling, or to increase or prolong it: and, therefore, even in the lowest and most simple cases, a faculty, if so it may be called, probably must be supposed to exist wherever there are feeling and volition.

There are various feelings, and modifications of feelings. The external world produces immediately as many as five kinds

[z] *Journal de Chimie Médicale*, Août, 1835.

in the most complicated beings; so that man is said to have five *external senses* — touch, taste, smell, hearing, and sight. The word touch is used to signify both the power of sensation on the contact of bodies, and also that general feeling which pervades every part, and is able to produce endless varieties of sensations from diversity of causes. If the external world, however, excites merely sensations, the knowledge is very scanty, and the execution of the will and the motives are as limited. But as we ascend in the scale of animals, faculty after faculty is added: so that various properties of the external world are learnt,—form is distinguished, and symmetry, and distance: the relation of colours, sounds, and numbers; and a power is at the same time given for viewing, as a whole, any object which excites these sensations and inner feelings, —so many *internal senses*, as some have named these powers.

As we continue to rise, powers still higher are given;—the power of viewing all things in connection, of comparing, contrasting, inferring: and in some individuals these, to which the term *intellectual powers* is especially given, are of great strength. At the same time, *motives* are given in increased numbers. The lowest animal has little more than a desire for food or life or an agreeable sensation, and an aversion from uneasiness: but to some, a desire of an act for the purpose of continuing the species; to others, a desire to construct a habitation, and in a particular manner; to some, a desire to attack and destroy, &c., is given,—desires few or more and in various proportions. These are all internal feeling, or so much consciousness. Now, any feeling may not only occur, so that sensation, perception, or consciousness are common attributes; but, when a feeling occurs which had occurred before, the circumstance that it is the recurrence of a feeling may be noticed. An odour may be recognised as one smelt before; a desire, a thought, as one experienced before. The philosopher may recognise a great thought as not new to him; and the lowest animal may probably be aware that a savour is the same it experienced once before. This is called *memory*. The impression may return in an obscure manner, without the recurrence of the original cause: so that we feel we had it before, — we remember having witnessed something. Feelings from even external causes may recur without the recurrence of the external cause. The impression is not so lively as when excited originally; if we figure to ourselves a building which we have seen, the feeling, though strong enough for thinking and discoursing

upon, is far short of that experienced with the aid of the external senses. In diseased states of brain, the feeling, however, is as strong as before; as well as where a large portion, but not the whole, of the brain is torpid, or, in other words, a large number of faculties are inactive, and not merely inactive, but roused to full action with difficulty, as in dreaming. The insane and the dreamer, from the powerful action of parts only of the brain, have as strong impressions as though they were employing their external senses.

Any feeling or train of feelings may be thus renewed; a string of words be conceived, though perhaps, at the time, neither heard, spoken, nor written, or even a train of thought. Whether a former impression is directly excited from without, as it was at first, and recognised; or whether feelings of any kind are re-excited from merely internal or indirect external causes of excitement, and recognised; or whether the impression of the former occurrence of any feeling is renewed;—in all these cases of memory, or perhaps more properly, in regard to the two first instances, recognition, the matter is precisely the same.

The mere recurrence of former impressions, without regard to their recognition, is termed *imagination* or *fancy:* and innumerable combinations of past impressions may occur, in such form and order as they did not occur before; and it is to this, strictly, that the term imagination or fancy is generally applied.

Feelings thus re-excited, whether intellectual or moral, do not start up insulated, but draw forth one another in *association*—just as they previously occurred in combination or in succession. An odour will re-excite the idea of the place where such an odour was vividly perceived; and all the circumstances and occurrences of the place will present themselves to the mind in succession or conjunction. It is thus that language spoken and written is an instrument of connection. Any connection between two feelings, of any kind whatever, serves this purpose; and every faculty may be thus excited; and the excitement of the very propensities excites ideas connected with the propensity, and the excitement of any one faculty may excite another.

While any feeling takes the lead, we are said to attend to it. We can for a time keep it steadily vivid. This power is called *attention*. The lowest animal can attend to its sensations, just as the greatest philosopher to his profoundest thoughts. We cannot call up a thought or feeling at pleasure; but, by keeping vividly

before our mind any present feelings connected with it, it sooner or later springs up through association, perhaps very complicated: and in this way, by keeping up impressions connected with certain propensities, we can excite even our propensities. The other mode in which our will operates, is by causing muscular contraction. We can will attention, and will muscular motion.

We are able to compare feelings of all kinds, and to infer one thing from another. This is called *judgment*. The animal, with but two external senses, taste and touch, judges of the quality of what it tastes and touches, — whether the object is like that to which he is accustomed. An animal with sight also judges if the aspect of food or drink is like that to which it is accustomed. With the faculty for the feeling of the relation of tones, it judges of music; with that relating to numbers, it judges of them.

To draw large inferences, see the relation of many feelings, and judge of cause and effect, seems a peculiar faculty; and, like all the rest, may exist in various degrees of force.

All these powers, of course, tend to action; and the various mere propensities are so many tendencies to action. Their impulse is called *instinct*[a]; and their highest tendency to excitement, *passion*. But instinct and passion are common to them all.

These modes or different operations of faculties were considered by old writers, and are still considered by those whose knowledge is but the remains of the ignorance of former days, as fundamental faculties. Every faculty, when it acts, acts in the way of one of them; so that they are nearly common to all our faculties; and, except attention, which is an act of volition, they are all modes only of action. Gall, therefore, instead of dividing them into perception, attention, memory, judgment, &c., as fundamental faculties; and viewing "the Power of Taste, a genius for Poetry, for Painting, for Music, for Mathematics," &c., as "more complicated powers or capacities, which are gradually formed by particular habits of study or of business[b];" regards these last powers as distinct faculties, and perception, attention, memory, judgment, &c., merely as modes or varieties common to the action of each faculty. He contends that, when we see a boy, *brought up exactly like his brothers and sisters*, dis-

[a] Some limit the term instinct to the natural tendency to an act, without any knowledge of its purposes.

[b] Dugald Stewart, *Outlines of Moral Philosophy*, p. 10.

playing fine musical talents or an astonishing power of calculation, *though in all other respects a child*, his pre-eminence cannot be explained by particular habits of study or of business, nor by mere strength of judgment, memory, &c.: — That the boy has a strong perception of melody, a strong memory of tunes, a strong musical imagination, a strong musical judgment, or a strong perception, memory, and judgment, of numbers; but may not be clearer-headed or more attentive on any other point: while men of the strongest sense may have no perception, memory, or judgment, of tunes, or may calculate with extreme difficulty. It is the same with regard to instinct. Writers consider instinct a general faculty, while it is only the inherent disposition to activity possessed by every faculty; and there are, therefore, as many instincts as fundamental faculties. By instinct "the spider spreads a web and ensnares flies: the working bee constructs cells, but does not kill flies to support itself; it takes care of the young, but does not copulate. Many male animals copulate, but take no care of their young: the cuckoo, both male and female, abandons the charge of bringing up its young to other birds, although it is compelled to copulation by a very ardent instinct. The castor builds a hut, but neither sings nor hunts; the dog hunts, but does not build; the butcher-bird sings, builds, and preys; the quail does not mate, but copulates, takes care of its young, and migrates; the partridge mates, copulates, and takes care of its young, but does not migrate; the wolf, fox, roebuck, and rabbit, marry, and take care of their young conjointly with the female: the dog, stag, and hare, copulate with the first female they meet, and never know their offspring. The vigorous wolf, the artful and timid hare, do not burrow like the courageous rabbit and the cunning fox. Rabbits live in republics, and place sentinels, which is done by neither the fox nor the hare. How can these various instincts exist in one species of animals, and not in another? How can they be combined so differently? If instinct were a single and general faculty, every instinct should show itself, not only at once, but also in the same degree; and yet while in the young animal many instincts act with great force, others are still quite inactive: some instincts act at one season, others at another. There is one season for propagation, another for emigration; one season for living solitarily; another for assembling in companies, and for collecting provisions. And how can we explain, on the supposition of a general instinct, why the different instincts do not exist merely separate in dif-

ferent species of animals, but that many of them are even contradictory?"[c]

For my own part, when I reflect upon the *various* talents and dispositions of persons who are all placed in the *same* circumstances, — how unsuccessfully some apply, with the *utmost perseverance*, to a branch of study, in which another, under the *same* instructors, or, perhaps, *scarcely assisted at all*, or even with every *impediment* thrown in his way, reaches excellence with little trouble, and, again, fails in one in which the first is, on the other hand, *successful*,—how early *various* tempers are developed among children of the *same* nursery, — how the best moral education is often thrown away, while in the midst of the worst examples and every incentive to vice a virtuous character is sometimes formed, — how *hereditary* are peculiarities of talent and of character, — how *similar* some persons are to each other in one point of talent and character, and *dissimilar* in another, — how positively *contradictory* many points of the *same* character are found; — how exactly the same is true of all species of brutes[d], and of all individuals among them, as far as their faculties are the same as ours, — each species having its peculiar nature, and each individual its peculiar character: — I confess myself unable to deny that there is one innate faculty for numbers, another for colours, a third for music, &c., &c., with a variety of distinct innate propensities; and that memory, judgment, &c., are but modes of action common to the different faculties.

The faculties of whose existence Gall satisfied himself are: 1. The instinct of generation; 2. The love of offspring; 3. The disposition to friendship; 4. Courage; 5. The instinct to destroy life; 6. Cunning; 7. The sentiment of property; 8. Pride; 9. Vanity; 10. Circumspection; 11. Sense of things, by which we take cognisance of individual objects and occurrences; 12. Sense of locality, or of the relations of space: 13. Sense of persons; 14. Sense of words; 15. Sense of language, or philological talent; 16. Sense of the relations of colours; 17. Sense of the relations of tones; 18. Sense of the relations of numbers; 19. Sense of construction; 20. Comparative sagacity, by which we compare;

[c] Gall, l. c. 4to. vol. iv. p. 332. sqq., 8vo. t. vi p. 352. sqq.

[d] See the poet Cowper's amusing account of the different characters of his three hares. But all persons conversant with horses, dogs, cats, or any other domestic brute, know that every individual among them is proportionally as different in its various abilities and dispositions, from others of its species, as every human being is from other men.

21. Metaphysical sagacity, by which we examine into cause and effect; 22. Wit; 23. Poetic talent; 24. Goodness, and moral sense; 25. Faculty of imitation; disposition to have visions; 26. Religious feeling; 27. Firmness. He had been long inclined to admit also a sense of order and a sense of time, and waited only for proofs of their organs.

Gall gives various other names to each faculty, more anxious to express his view of the nature of each than to quibble for appellations.[e]

For information respecting the precise nature of each faculty, many of which may be ill understood from their designations, I refer to the third and fourth volumes of Gall's work, *Anatomie du Cerveau*, and the third, fourth, and fifth volumes of his *Fonctions du Cerveau* — portions of the work which the most indolent will find entertaining.

That the faculties enumerated are not modifications of each other, or of any other, but distinct and primitive, Gall considers proved by the circumstance of each having one or more of the following conditions.

"An instinct, inclination, sentiment, talent, deserves," says he, "the denomination of fundamental, primitive, radical:

"1. When a quality or faculty (or its organ) is not manifested nor developed, nor diminishes, at the same time with others. Thus the instinct of generation (with its organ) is generally developed and manifested later than other inclinations. Thus, the memory of names usually grows weak sooner than the other faculties.

"When, in the same individual, a quality or faculty is more or less active (and its corresponding cerebral part more or less

[e] Dr. Spurzheim gave to the majority of these faculties new names, which he afterwards changed from time to time, some of which were long and uncouth, and still destitute of the uniformity he aimed at, some new-coined words, and some expressive of a doubtful, if not decidedly erroneous, view of the faculties; and to most of which Gall objected, as I confess I do. Dr. Vimont thus gives his opinion of them: — "Des expressions ridicules. J'ai vu avec plaisir que les medecins les plus distingués en France n'ont jamais pu condescendre à recevoir les mots sécrètivité, marveillosité, &c. — langage prétentieux, de mauvais goût, et qui figurerait à merveille dans la comedie des Précieuses Ridicules, ou des Femmes Savantes." (*Traité de Phrénologie*, 4to. Paris, t. ii. p. 105.) It would have been much better to have followed the example of Gall, and rested contented with a few names for each faculty, so as to show what was meant, and waited till the science is so far advanced that an appropriate name cannot be difficult.

developed) than the others. Thus, the greatest sculptors, painters, designers, have sometimes not the least disposition to music; the greatest poets little talent for mathematics.

"3. When a single quality or faculty is active, whilst the others are paralysed (and only the corresponding organ developed). Thus, persons imbecile in every other respect, are often violently impelled by physical love, or have a great talent for imitation, &c.

"4. When, all the other qualities and faculties being active (and all the other organs sufficiently developed), one single quality or faculty is inactive (and one single organ not developed). Thus, certain individuals cannot comprehend that two and two make four; others detest music, or women.

"5. When, in mental diseases, one quality or faculty only suffers, or one only is entire. Thus, one insane person is mad only in regard to religion, to pride, &c.; another, although mad in every respect, still gives lessons in music with great intelligence.

"6. When the same quality or faculty is quite differently manifested in the two sexes of the same species of animal (and the organ is differently developed in the two). Thus, the love of offspring (with its organ) is more developed in the females of most animals: thus, among singing birds, the male only sings (and has the organ well developed).

"7. Lastly, when the same quality or faculty (and the same organ) always exists in one species and is deficient in another. Thus, many species of birds, the dog, the horse, &c., have no inclination (nor organ) for construction, though this is so strikingly manifested in other kinds of birds, in the squirrel, in the beaver. Thus, certain kinds of animals are predaceous, migrate, sing, take care of their young, while other kinds are frugivorous, lead stationary lives, do not sing, abandon their offspring."[f]

[f] l. c. t. iii. p. 213. sqq. See also 4to. vol. iii. p. 81. These were Gall's own philosophic principles, resulting from a view of his discoveries, and employed by him to test farther discoveries. Yet Dr. Spurzheim details them with no important difference as his own, and says, "I have no hesitation to maintain that, in pointing out the social or fundamental powers of the mind, my proceeding is philosophical, founded on principles, &c.;" whereas "Gall did not determine any of the organs in conformity with these views." (*Phrenolog.*, vol. i. p. 137. American edition.) Gall began, of necessity, empirically; but these were the general principles which he laid down after his discoveries and published in the volumes which bear his name only. "I renounced all reasoning, and gave

Perception, memory, judgment, &c., are modes of action of these distinct faculties. "As often as there exists a fundamental faculty, a particular and determinate intellectual power, there necessarily exists likewise a *perceptive* faculty for objects related to this faculty. As often as this faculty is active upon the objects of its sphere, there is *attention*. As often as the idea or traces which the impressions of objects have left in the brain are renewed, either by the presence or in the absence of these same objects, there is remembrance, reminiscence, *passive memory*. If this same renewal of received impressions takes place by an act of reflection, by a voluntary act of the organs, there is *active memory*. As often as an organ or a fundamental faculty compares and judges the relations of analogous and dissimilar ideas, there is comparison, there is *judgment*. A series of comparisons and judgments constitutes *reasoning*. As often as an organ or a fundamental power creates, by its own inherent energy, without the concurrence of the external world, objects relative to its functions; as often as the organ discovers, by its own activity, the laws of the objects related to it in the external world, there is *imagination*, invention, genius.

"Whether, now, we consider perception, attention, memory, reminiscence, recollection, comparison, judgment, reasoning, imagination, invention, genius, either as gradations of different degrees of the same faculty, or as peculiar modes of being of this faculty, it still remains certain that all the fundamental faculties which have been demonstrated are endowed, or may be endowed, with perception, attention, memory, recollection, judgment, imagination; and that, consequently, it is they which ought to be considered intellectual and fundamental faculties, and that the pretended mental faculties of my predecessors are only common attributes. Here, then, is a perfectly new philosophy of the intellectual faculties, founded upon the details of the natural history of the different modifications of human intellect. The same may be said of the appetitive faculties, or rather qualities."[g]

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myself up entirely to observation. In this way I discovered twenty-seven qualities or faculties essentially distinct, which must all be reduced to fundamental qualities or faculties. It was only after this discovery that I was enabled to point out the characteristic conditions of the fundamental qualities or faculties." (4to. vol. iii. p. 81.) Then follow the seven characteristics.

[g] l. c. 4to. vol. iv. p. 327. sqq., 8vo. t. vi. p. 405. sqq., t. iii. p. 131. sqq.

"When a person has the talent for music, poetry, construction, judging of distance, &c., in only a weak degree, he will not have a very decided inclination for those objects. If, on the other hand, the organs of these fundamental forces are more energetic, the person feels a pleasure in the exercise of their functions; he has an inclination for these objects. When the action of these organs is still more energetic, he feels a want to occupy himself with them. Lastly, when the action of these organs preponderates, the person is impelled towards these objects; he finds his happiness in them, and feels disappointed, unhappy, when he cannot follow his inclination; he has a passion for these objects. Thus it is that certain individuals have a passion for music, poetry, architecture, travelling," &c.[h]

"'You shall not persuade me, however,'" Gall fancies it will be said to him, "'that the faculties acknowledged by philosophers as faculties of the soul, are chimæras. Who will dispute that understanding, will, sensation, attention, comparison, judgment, memory, imagination, desire, liberty, are not real operations of the soul, or, if you please, of the brain?'" "Yes," replies Gall, "without doubt these faculties are real, but they are mere abstractions, generalities, and inapplicable to a minute study of a species, or of individuals. Every man, who is not imbecile, has all these faculties. All men, however, have not the same intellectual or moral character. We must discover faculties, the various distribution of which determines the various species of animals; and the various proportions of which explain the varieties among individuals. All bodies have weight, all have extension, all have impenetrability; but all bodies are not gold or copper, all are not any plant, or any animal. Of what use to the naturalist would be the abstract and general notions of weight, extension, and impenetrability? If we confined ourselves to these abstractions, we should still be in the most profound ignorance of every branch of physics and natural history.

"This is exactly what has happened to philosophers with their generalities. From the most ancient period down to the present day, one has not made a single step farther than another in the precise knowledge of the true nature of man, his inclinations and his talents, or of the source of his motives and determinations. Hence we have as many philosophies as *soi-disant*

[h] l. c. 4to. vol. iv. p. 328. sq., 8vo. t. vi. p. 408.

philosophers: hence the vacillation and uncertainty of our institutions, especially of those which relate to education and criminal legislation."[i]

Gall does not pretend to have discovered the ultimate nature of *all* the fundamental faculties which he has pointed out. The poet's faculty, for example, he regards as distinct and fundamental, because it has the conditions of a fundamental faculty above enumerated; but what are the ordinary functions of that part of the brain, which, when greatly developed, produces the poet, he dares not determine.[k] "I have made it," says he, "an invariable rule to advance nothing which I could not strictly prove, or at least render very probable by very strong arguments: for this reason, in regard to the qualities and faculties, the existence of which I maintain, I have always confined myself to the degree of activity in which I could discover them and observe their manifestation. I know it would have been more philosophical always to refer to their fundamental forces the qualities or faculties which I could detect in only their highest action: but I preferred leaving something for those who came after me to do, rather than give them an opportunity to disprove what I had prematurely advanced."[l]

[i] l. c. 8vo. t. i. p. 49. sq. See also 4to. vol. iv. p. 318. sqq., and 8vo. t. vi. p. 392. sqq.

[k] l. c. 4to. vol. iv. p. 181., 8vo. t. v. p. 243.

[l] l. c. 4to. vol. iv. p. 275. sq., 8vo. t. v. p. 407. Gall was of opinion that there is a faculty for judging of time, and another of order. (l. c. 4to. vol. iv. p. 61. sq., 138. sq., 8vo. t. iv. p. 466. sq., t. v. p. 153. sqq.) He held, that there must be a faculty which determines the desire of a particular habitation (l. c. 4to. vol. iii. p. 314. 8vo. t. iv. p. 280.), and might be one which gives pleasure in wonders; but, like the faculties of time and order, he "was always of opinion that they should not be received into the list till the situation of their organs was proved by a sufficiently large number of exact observations." (l. c. 4to. vol. iii. p. xxiv. sq.) Dr. Spurzheim and phrenologists in general admit all four. Dr. Spurzheim splits Gall's sense of Things into two: one for objects, and one for occurrences. Gall conceives there is a cerebral organ for the desire of taking food (l. c. 8vo. t. iv. p. 63.); and Dr. Hoppe of Copenhagen is generally thought to have established it. (*Phrenolog. Journ.* Edin. Nos. 5. and 7.) Dr. S. assigns its establishment to a person who never uttered a word to us upon the subject till, many months after Dr. Hoppe's first paper was published and six weeks after the second paper had been read in the Edinburgh Society, he surprised us all in the London Phrenological Society by reading a paper upon the point. Gall originally fancied that there was a faculty of the love of life, and that he had discovered its organ; but he afterwards thought he had been mistaken. *Cranologie,*

Neither does Gall pretend to have enumerated all the fundamental faculties of the mind. "Probably," says he, "those who

ou Découvertes nouvelles du Docteur Gall, traduit de l'Allemand. Paris, 1807, p.72. Gall, 8vo. t. iv. p. 63. sq.) Dr. A. Combe, however, in the *Ed. Phr. Journ.*, 1826, contended that the love of life was a distinct faculty, and mentioned the case of an old lady who had long been remarkable for her love of life, and in whose brain the only thing peculiar was an enormous convolution at the base of the middle lobe. Dr. Spurzheim, without referring to Dr. A. Combe or any one else, coolly says *he thinks* "it is highly probable that there is a peculiar instinct to feel a love of life; and I look for its organ at the base of the brain, between the posterior and middle lobes, inwardly of combativeness." (*Phrenology*, ed. 1832, vol. i. p. 142.) Dr. Vimont says (*Traité de Phrénologie*, 1835, vol. ii. p. 165.), that persons assured him that Dr. S., in his lectures at Paris, in 1830, arrogated to himself the discovery of the organ. Dr. Vimont, however, is equally culpable with Dr. S.; for he not only says that Dr. S. made no such discovery, but that neither Gall nor Dr. S. speaks of the faculty; and Mr. G. Combe only in the third edition of his *System of Phrenology*, in 1830. Now, 1. Dr. Spurzheim did mention it in his edition of 1832, under the beautiful name *vitativeness*; and Gall long before, though to disprove it. 2. In the passage which Dr. Vimont refers to, in Mr. G. Combe's work, the case seen by Dr. A. Combe is fully detailed from the *Ed. Phr. Journ.*, vol. iii. p. 467. sqq., published in 1826. But, Dr. Vimont's mention of it is in his second volume, published 1835, p. 105. and 160. sqq.; and he there says that he mentioned it in a memoir presented to the French Institute only in 1827.

Gall, in treating of attachment, gave strong reasons, in opposition to Dr. Spurzheim, for believing that there is a faculty for marriage. Dr. Vimont fancies that he himself has established this; as well as, in certain brutes, a faculty which he calls *sens géométrique*, inclining them, when moving in numbers, to arrange themselves in a certain figure; and one in men, which he terms *sens du beau dans les arts*. Dr. Spurzheim conceived that there is a distinct faculty for judging of weight or resistance, one for judging of size, as well as one of hope.* Gall was opposed to all three. In Edinburgh they fancy there is a faculty for keeping other faculties in simultaneous action towards one object, and they call it concentrativeness. Dr. Spurzheim argues against it through no fewer than eleven pages; and Gall considered it unfounded. Dr. Spurzheim says that a friend of his, a M. De Tremmon of Paris, suggested the idea of an organ of which agriculture is the result. (*Phr.*, Am. ed. vol. i. p. 168.) An Irish gentleman, who had just commenced the study of phrenology, announced the discovery of seventy-four new faculties one night to the Phrenological Society of London. It appears to me, however, that there must be a faculty which makes us wish to communicate our ideas to others, and another which makes us love society. Some persons can keep nothing for an instant. Now no want of secretiveness (if there is such a faculty, though Gall more properly, as I imagine, con-

* *Phrenology, or the Doctrine of the Mental Phenomena.* By G. Spurzheim, M.D. 2 vols. Boston, 1832. Editions of some of his works, with his latest corrections, were printed there by Marsh, Capen, and Lyon, 1832–3.

follow me in the career which I have opened, will discover some fundamental forces and some organs which have escaped my researches."

He doubts, however, whether so many will be discovered as some apprehend. A modification of a faculty must not be mistaken for a faculty, nor the result of the combined action of several faculties for a particular faculty. "If," he says, "we reflect on the number of possible combinations which may result from the twenty-seven or thirty fundamental faculties or qualities, from the reciprocal action of as many organs, we shall not be surprised at the infinite number of shades of character among mankind. How many different combinations result from the ten ciphers, from the twenty-four letters. How many different countenances result from the different combination of the small number of parts which compose the human face: how many shades of colours and tones result from the small number of primitive colours and fundamental tones." [m] They, moreover, may be variously modified in different animals.

This view of the mental faculties may be considered quite independently of the peculiar doctrines of Gall respecting the cerebral organs of each faculty, and even quite independently of the fact of the brain being the organ of the mind. It may be examined precisely like the metaphysics of Locke, Reid, Stewart, Brown, &c. [n]

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siders that what Dr. S. names secretiveness is a disposition to artfulness and stratagem) can explain it. There must be a positive propensity. The disciples of Dr. S. must allow that the want of a disposition to conceal would not impel a person to communicate; as they maintain, in opposition to Gall, that the deficiency of combativeness will not give fear, nor of any feeling its opposite. Again, some persons, not at all remarkable for attachment, cannot bear to be alone; they have a propensity to society too strong to allow them to be alone a moment, though they have no regard for the person whose presence may suffice them. Gall is decidedly of this opinion (l. c. 4to. vol. iii. p. 175. sq., 8vo. t. iii. p. 492. sq.); and, having been unable to localise the tendency, is inclined to regard it as a modification of attachment. Solitariness and silence are dreadful punishments.

[m] l. c. 4to. vol. iv. p. 275., 8vo. t. v. p. 406. sq. Bacon, *De Dignit. et Aug. Sc.* l. vii. cap. ii. is striking on this point.

[n] It is remarkable that nearly every one of these faculties has been admitted by one metaphysician or another. See Mr. G. Combe's Letter in reply to Mr. Jeffrey, the editor of the *Edin. Review*, reprinted in the *Edin. Phrenol. Journal*, 1827.

Notwithstanding, too, that memory, like judgment, attention, &c., was con-

It, however, derives its great proofs from the fact of the individual faculties being, cæteris paribus, strong in proportion to the development of particular parts of the brain, as we shall presently see.

Every faculty was given us for a good purpose, and it is only when one or more are excessive, or defective, or too much or too little excited by external circumstances, or by disease, that error occurs. The lower faculties given to brutes as well as to ourselves are evidently to yield to those which are of a superior nature and peculiar, or given in a higher degree and with peculiar modifications, to man. Happiness is "our being's end and aim." Not individual, partial, temporary happiness, however intense; but the greatest and longest happiness of the greatest number. Sound morality in individuals and nations,—and in what, through elective representation should be, at least virtually, identical with a nation,—government, tends to this. No act is virtuous that does not lead to the greatest happiness of the individual and of the greatest number of individuals: nor does any act lead to the greatest happiness of the individual and of the greatest number, that is not virtuous. The whole set of faculties, each allowed to act, but the inferior in subordination to the superior, lead to virtue; and this to happiness. "All the faculties," says Gall, "are good, and necessary to human nature such as it should be according to the laws of the Creator. But I am convinced that too energetic an activity of certain faculties produces vicious inclinations — causes the primitive destination of propagation to degenerate into libertinism, the sentiment of property into an inclination for theft, circumspection into irresolution and a tendency to suicide, self-love into insolence, disobedience, &c."[o] To employ all our faculties so as to produce the largest amount of individual and general happiness, therefore, is the law of our nature; and, like all the laws of nature, is intended to be obeyed. When we attempt to act contrarily to any law of nature, evil arises either to ourselves immediately or ultimately, to others

sidered a distinct and fundamental faculty, some writers taught that there were three sorts of memory; one for facts (*memoria realis*), one for words (*memoria verbalis*), and one for places (*memoria localis*). See Gall, l. c. 4to. vol. iv. p. 14. sq., 8vo. t. iv. p. 380. Some, that there are four; a memory for words, another for places, a third for time, and another for cause and effect, or causality. See Gall, l. c. 4to. vol. ii. p. 357. sq., 8vo. t. ii. p. 353.

[o] l. c. 4to. vol. iii. p. xxxi.

contemporaneous with us, or to our successors, be they our progeny or not. To obey them is, therefore, our solemn duty. Christianity teaches the very precepts which lead to the greatest happiness: and, if any one disregard the authority of them as taught by Christ, because he sees no proofs of Christ's superhuman authority, he must remember that they are already established in nature; and that Bishop Butler himself, in his *Analogy*, declares that man, "from his make, constitution, or nature, is, in the strictest and most proper sense, a law to himself, — he hath the rule of right within,"[p] and that Christianity, as regards its moral precepts, is a republication "of natural religion in its genuine simplicity," and that "moral precepts are precepts the reason of which we see," and "arise out of the nature of the case itself, prior to external command."[q]

So imperative are the natural moral laws, that a man is equally bound to obey them and be virtuous, though he disbelieves not only the divine authority of Scripture, but a future state. Indeed, in proportion to the necessity of being influenced in our conduct by the hope of future reward or the fear of future punishment must be the deficiency of real virtue. Nay, a man would be equally bound to obey the moral laws, though, notwithstanding the evidence of universal design, he should, from the difficulties of the subject, reason himself into a doubt of the personality of

[p] *Sermon* iii.

[q] *Analogy*, P. ii. c. i. Melancthon says, "Wherefore our decision is this, that those precepts which learned men have committed to writing, translating them from the common sense and common feeling of human nature, are to be accounted as not less divine than those contained in the tables given to Moses; and that it could not be the intention of our Maker to supersede by a law given on a stone, that which is graven with his own finger on the table of the heart."

Volney's *Loi Naturelle* deserves reading; and that part of Dr. Spurzheim's *Phrenology* which relates to the moral constitution of man. Mr. Combe's work on the *Constitution of Man* is plain and forcible, and should be in every body's hands, as a guide to happiness and a protection from absurd and superstitious notions. Through a phrenological benefaction, its price is very low.

Upon the subject of metaphysics, or the science of mind, all our knowledge, I think, may be found in Gall's works, — *Sur l' Anatomie et Physiologie du Systême Nerveux*, and his *Fonctions du Cerveau;* in Dr. Spurzheim's *Phrenology*, in 2 vols; and in the admirable *Lectures on the Philosophy of the Human Mind*, by Thomas Brown, M.D. Edinb. 1826, 1 vol. 8vo.

Dr. Thomas Brown is not only among the ablest metaphysical writers, but is the latest, and his work approaches as near to phrenology as was possible without the aid of Gall's method of investigation.

the great cause of creation. The wicked man who holds any of these opinions, in the idea of being loosened from the bonds of virtue, is as ignorant as he is wicked.

Bishop Butler, in his profound metaphysical sermons, preached at the Roll's Chapel, and which all should study, proves that the natural tendency of all our united faculties and feelings is to virtue and the greatest happiness.[r]

[r] *Serm.* i. Upon the social nature of Man. *Serm.* ii iii. Upon the natural supremacy of conscience.

Some have, in the most bigoted manner, denied that there is any foundation for virtue, but in revelation. "I never took any pleasure in *moral ethics*," says Mr. Gilbert Wakefield (*Memoirs of his own Life*, vol. i. p. 512.), "and would not give one penny for all the morality in the world." Yet, as the present Dean of Peterborough, Dr. Turton remarks (p. 222.), "this gentleman wrote a book of about 230 pages in defence of Christianity; and the volume is almost entirely confined to the internal evidences and moral excellence of the system. It is not unpleasant to observe the natural feelings of people thus completely overthrowing their theoretical positions. 'Natural religion,' Dr. Hey observes 'is pre-supposed in revealed.'" Socinus even declared (Toulmin's *Memoirs of Faustus Socinus*, p. 216.) that no man could discover the truths of natural religion, not even the being of God, by the light of nature; "and that the first notices of a Divine Being were derived from Revelation or immediate communications from God." Archbishop Magee held the same doctrine; and Bishop Horne and the greater defender of the Trinity, Mr. Jones, went further, by believing the Bible to contain a system of natural philosophy ("as certain critics," equally absurd in regard to another book, "are used to say, hyperbolically," that if all sciences were lost, they might be found in Virgil, (Lord Bacon, *Advancement of Learning*), and, by becoming disciples of a person named Hutchinson, who thought that, by the "light which revelation afforded him, compared with his own observations, he saw farther into the constitution of the universe, and the operations carried on in it, than Sir Isaac Newton had done." (Bishop Horne's *Works*, vol. i. p. 445.) "Mr. Hutchinson looked upon natural religion as an engine of the devil, in these latter days, for the overthrow of the Gospel; and therefore boldly called it the religion of Satan or Antichrist." The fancy was, however, old. "Paracelsus and some others," says Lord Bacon (l. c.) have pretended to find the truths of all natural philosophy in the Scriptures, scandalising and traducing all other philosophy as heathenish and profane." "But neither do they give honour to the Scriptures, as they suppose, but much embase them." "The scope or purpose of the spirit of God is not to express matters of nature in the Scriptures otherwise than in passage, and for application to man's capacity and to matters moral and divine; and it is a true rule *auctoris aliud agentis parva auctoritas;* for it were a strange conclusion, if a man should use a similitude for ornament or illustration sake, borrowed from nature or history, according to vulgar conceit, as of a basilisk, an unicorn, a centaur, Briareus, an Hydra, or the like; and that therefore he must needs be thought to affirm the matter thereof positively to be true." — The mind is a subject of natural

We will now consider the special functions of the different parts of the nervous system.

The mind is evidently the property of the brain; and the operations of the mind, whether relating to sensation, will, intellect, or affections, are evidently the operations of the brain. In the division of this work devoted to general physiology, I proved the brain to be the organ of the mind, as much as the liver is the organ of the secretion of bile; that what holds good of the function of every other part, holds good of the function of the brain; and that to ascribe the power of the brain to an immaterial imaginary something called a soul, is a mere hypothesis, the remains of unenlightened times, and not only unnecessary to the belief of a future state through a divine revelation, but calculated to throw discredit on such revelation, by making its annunciation of a future state appear superfluous.[s]

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science, and Lord Bacon's remarks apply to it equally as to astronomical and geological matters; and I consider that a soul stands upon the same foundation as a centaur or a Briareus.

[s] An old argument, which I thought too puerile to notice, and which was disposed of by Gall (l. c. 8vo. t. iii. p. 119. sq.), has just been revived by Lord Brougham to uphold the existence of something called soul distinct from matter. (Paley's *Natural Theology, illustrated* by Henry Lord Brougham. London, 1835. The body is said to be incessantly changing its constituent particles, so that no part of it is the same after a certain lapse of time; and yet we feel ourselves to be mentally the same. Now, the change of the particles of the body may be granted. But what then? Do not all the properties of all parts of the body remain the same, as much as its mental character? are not the fresh particles so assimilated to each part, that all we can see or feel of our bodies, and the qualities of every part, remain the same, as much as all we observe of the mind, throughout all the changes of particles? Is not a man held to be the same bodily as well as mentally all the days of his life? If the face is marked with the small-pox, do not the pits remain throughout life, though the particles may have all changed ten times? If a nervous or dyspeptic affection exists hereditarily, does not the morbid functional peculiarity continue through all the repeated changes of the particles? If a person acquires immunity from small-pox by vaccination, or by having once passed through the disease, is he not in nearly all instances safe against it, though he live long enough to change all his particles again, and again, and again. What is true of all other organs and parts is true, to just the same extent, of the brain, in regard to its substance and its qualities.

An assertion of Lord Brougham's, that the mind does not decay with the body, but acquires vigour while the body declines, is incorrect. "It is equally certain," says he, "that while the body is rapidly decaying, between 60 or 63 and 70, the mind suffers hardly any loss of strength in the generality of men: that men continue to 75 or 76 in the possession of all their mental powers, while few

If it is clear that the brain is the organ of mind, it is extremely probable that particular portions of it have different offices.

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can boast of even their physical strength; and instances are not wanting of persons, who, between 80 and 90, and even older, when the body can hardly be said to live, possess every faculty of the mind unimpaired." (p. 120.) This statement is perfectly opposite to sound observation. Gall published when between 60 and 70, and in conversation appeared in full possession of his intellect; nay, as to cerebellum and body at large, he declared that he never omitted matrimonial duties for 24 hours. Madame Gall assured me, in regard to the whole man, "que le docteur n'étoit pas épuisé; que ses forces n'étoient pas diminuées!" But what he wrote did not contain a single discovery or new view, and was merely the offspring of his former labours and mental powers. He told me his mind's vigour was impaired, and his head somewhat diminished. A man's judgment may become greater near 60; not from greater strength, but from enlarged experience and longer habit. But let him attempt what is not habitual with him, or let him attempt originality, and, though he may not discover his decline, the rest of the world will. The Archbishop begged to be informed when his sermons showed his mind to be falling off; but was offended beyond forgiveness when Gil Blas told him that his last homily "ne paroît pas tout-à-fait de la force des précédents." "Mon esprit, grace au Ciel," replied the indignant old man, "n'a rien encore perdu de sa vigeur." When old men work at something original, or pursue a course of public intellectual effort, their falling off is manifest, and we discover that the phrase 'retained their faculties to the last,' is vague and incorrect, just as I formerly remarked it to be when applied to persons near dissolution. I am not aware of any great discoveries or original productions by men who had attained the age of 60; but, should any instances of full mental vigour in old men be adduced, they would only be exceptions, just like octogenarian fathers, or persons who we see continually in the papers lived to 90 or 100, and walked so many miles daily to within a week of their death for I know not how many years. An eminent agriculturist has been begetting a family at past 70.* Yet who would fix upon a man of 70 as a postman, or to ensure an heir? Are not elderly men found to fall off from their full and palmy condition of mind, till they all acquire the title of old women? There may be varieties in the period of general decline, as there are of full development; and there may be varieties in the decline of different organs in the same system. Will not the stomachs of some old men receive and digest food as well as those of young ones? But decline arrives; and those who use such arguments should show that the

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* Every Sunday newspaper records the death of some wonderful old poor person, and I take this by chance from the *Morning Chronicle* of the 30th of last November. "The veteran Lord Lynedoch has been visiting at Holkham; and we are happy to understand that, notwithstanding his advanced age (we believe the venerable General to be in his ninety-second or ninety-third year), he enjoys the diversion of shooting, and sees well enough to kill a hare. Mr. Coke (the agriculturist I alluded to) enjoys and directs the battues with the same health and energy he has done for many years."

Numerous old writers had assigned situations for the faculties, but in the most fanciful manner; and, from regarding as distinct

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mind does not require sleep, is not weakened by over-exertion of the brain or any other part, by want of food, by cold, &c., and is not affected by narcotics and stimulants. Those who wish to show the mind independent of the brain in one point, must show it in all.

In reply to the argument for an immaterial something from the consciousness of personality, I reminded my readers formerly that the fly must be as conscious of its individual being — its personality — as the philosopher about whose head it buzzes. If he must be believed to have an immaterial and immortal soul on this account, so must the fly, and so must the smallest microscopic creature. Nay, if an animal is of such a nature that it will re-acquire bodily perfection, or can live when divided into two or more, its mind can do the same: so that a *planaria's* consciousness may be made into two or ten if we please (see suprà, p. 254.) — each new animal made from sections having its sense of personality, and therefore its pretension to an immaterial principle, as much as the original and as much as a philosopher; and simply because its sensorial nervous system, though divided, fully thrives. Our own minds, and those of all other animals, are known to us only as powers generated merely by matter, through being of a certain composition and placed under certain circumstances, possessing or acquiring the property of changing and developing, till at length brain results, with its mental properties; and, as the respective parts of this brain are farther improved in texture and developed, so increased and fresh faculties appear. The properties of every other organ come in the same way.

Lord Brougham (p. 102. sqq.) censures former writers for not using an argument which, unfortunately for their characters as observers of nature, was used by Drs. Barrow (7th *Sermon on the Creed*), Bentley (*Sermon* ii.) Clarke (*On the Being and Attributes of God*, Prop. viii.), Reid (*Essays on the Powers of the Human Mind*, vol. i. p. 97.), Beattie (*Dissertations*, chap. i. sect. i.). A particular combination of matter, he asserts, cannot give birth to what we call mind, because this would be "an assertion altogether peculiar and unexampled," of which "we have no other instance;" because "we know of no case in which the combination of certain elements produces something quite different, not only from each of the simple ingredients, but also different from the whole compound," — "both the organised body and something different from it and not having one of its properties — neither dimensions, nor weight, nor colour, nor form." (p. 102. sqq.) — "To think," says Dr. Barrow, in anguish, "a gross body may be ground and pounded into rationality, a slow body may be thumped and driven into passion, a rough body may be filed and polished into a faculty of discovering and resenting things; that a cluster of pretty thin round atoms (as Democritus, forsooth, conceited), that a well-mixed combination of elements (as Empedocles fancied), that a harmonious contemperation (or crasis) of humours (as Galen, dreaming, it seems, upon his drugs and his potions, would persuade us); that an implement made up of I know not what fine springs, and wheels, and such mechanic knacks (as some of our modern wizards have been busy in devising), should, without more to do, become the subject of

faculties what are merely modes of action of faculties to which they were altogether strangers, their assertions on the subject were

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so rare capacities and endowments, the author of actions so worthy and works so wonderful, &c. &c. — how senseless and absurd conceits are these! How can we, without great indignation and regret, entertain such suppositions?" As a son of Galen, I would reply to Barrow ("dreaming, it seems, upon his" dusty folios of divinity in his study, instead of looking abroad through nature) and to Lord Brougham, — 1. That the brain, matter though it be, is seen, in positive fact, to have these capacities and endowments — that it has them in proportion as it is better organised and has a greater bulk of its respective portions — that the mental phenomena are disturbed by all the means, applied to the brain, that disturb the functions of other organs when applied to them: 2. That there is an insensible transition of mental qualities from the lowest brutes through the cleverest, and through human beings of the dullest apprehension and feelings (many of whom are far below most brutes) to the highest among us; and that the mental properties of the lowest are neither "dimensions, nor weight, nor colour, nor form," any more than the mental properties of ourselves, and must therefore arise from something more than matter, or our high capacities may be merely properties of matter. What faculty or degree of faculty that appears in the scale of animals is the first sign of soul? Nay, the properties of simple life, such as vegetables have in common with us, are neither "dimensions, nor weight, nor colour, nor form,"— they cannot be produced by "grinding, pounding, thumping, driving, filing, polishing, by springs, wheels, and such mechanic knacks." They, I suppose, are not now ascribed to a soul, though they once were, and ought to be still by such believers in souls.

The vital properties of a cabbage, I presume, are allowed to result from a well-mixed combination of elements; and if such a combination produces such a result, other combinations may and do produce results still higher. What in common with extension, impenetrability, and inertness, have heat, electricity, magnetism? yet matter placed under certain circumstances displays these properties; and a change of circumstances changes them. Biniodide of mercury is yellow; but reduce its temperature to a certain point, nay, only touch it, and instantly it becomes red. Soft iron and nickel have magnetic properties at a certain temperature, but suddenly lose them at a higher, and nickel at a less elevation than iron. Soft iron connected with a magnet, or encircled by a coil of copper wire and connected with a galvanic battery, becomes magnetic, but no longer than the connection lasts.

What property of dimension, weight, &c., is that possessed by mercury, iron, and so many other elements, of variously affecting living natures, both corporeally and mentally? A few elements combined in various proportions acquire various such properties, and, in some, properties of the most deadly kind. Prussic acid is only certain proportions of carbon, nitrogen, and hydrogen — all which, in other proportions and combinations, are essential elements of our bodies. The living matter of vegetables and animals is common matter arranged and compounded as in no other instances, and which, properly circumstanced as to temperature, &c.

necessarily groundless and ridiculous. Burton, for example, in his compilation, says, "*Inner senses* are three in number, so called

gives rise to the phenomenon of life. When living matter arranges itself, according to its properties, into that peculiar combination which we call nervous, other peculiar phenomena appear; and if its vital powers arrange it into that composition and organ called brain, and this is properly circumstanced, mind appears. In truth, no combination of elements and arrangement of matter thus combined occurs in inanimate substances as we find in vegetables; no such combination of elements and such organisation in vegetables as we find in brutes; and no such combination and organisation in the other organs of brutes as we find in the brain, and the brain of no brute is equal to the development of its various parts to the human brain. The vital and mental phenomena are unexampled in the inanimate world — result from no combination or organisation there, simply because no such combination and organisation occur in the inanimate world. Combine and organise inanimate matter by supplying seeds and young plants with proper inanimate matter, and every vegetable may be generated from one or two, in indefinite abundance, as long as matter is supplied and necessary circumstances attainable; and you give living properties to matter previously inanimate. You may do this equally with animals, and thus multiply minds; you may do it equally with human animals, and thus multiply human minds indefinitely — generate souls! Nay, you may generate what quality of mind you please, just as you may generate the properties of a rose, or of a lily if you prefer them, by propagating from a rose or lily, thus converting inanimate matter into roses or lilies; and just as you can propagate the intellectual and moral qualities of the intelligent and affectionate dog, or the musical qualities of the bulfinch, if you prefer them, by propagating dogs or bulfinches, thus converting inanimate matter into dogs and bulfinches. You may generate not only human faculties, but any variety of them you please, as much as you can varieties of body, by propagating and feeding different varieties of human beings, — by converting common matter into human beings, and human beings of whatever sort is preferred. Propagate from cretins in Switzerland, and you have idiotism; from sagacious parents, and you have intelligence; from parents endowed with a specific talent, you produce this talent, be it musical or any other; from violent, vicious, half mad parents, and you beget a curse to mankind, in ferocity, depravity, or eccentricity; from mad parents, you produce madness; from the gentle, and benevolent, and affectionate, you generate gentleness and love. With but one parent so marked, you may often succeed in generating his or her qualities; and when, with two alike, you fail, the failures are not more frequent, nor caused by other circumstances, than failures of transmission of corporeal resemblances, or of the transmission of the mental qualities of brutes or of the properties of vegetables. Strange souls, to be thus under our command as to numbers and qualities! So far from there being, as Lord Brougham says, no case in which the combination of certain elements produces something quite different, the world is incessantly filled with such cases; all the vegetable and animal creation are examples of inanimate matter incessantly combined into the production of new qualities totally different from those previously possessed.

because they be within the brain-pan, as *common sense*, *phantasie*, and memory." Of "common sense," "the forepart of the brain is

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It is asserted by Lord Brougham, who positively says that we have a "perpetual sense that we are thinking," "quite independent of all material objects," (p. 56.) that the circumstance of the existence of matter is only an hypothesis, and that materialists grossly and dogmatically assume that matter exists. Now, we do not assume — we know, that matter exists. From certain sensations, we believe inevitably, intuitively, by the laws of God, that what we term matter exists. He allows, indeed, "that we believe in the existence of matter, because we cannot help it." (p. 241.) This is enough. As to our minds, we observe that no mind exists in nature but as a property or power of matter. We never see mind. We certainly learn the existence of matter by the property of our brain called mind: but that is no reason for saying that the power called mind exists alone. If it were felt by ourselves to exist, though we had no knowledge of matter around us, it would only show that we felt personality without knowing the cause of it, — without knowing that we had brains. It would show our ignorance only. The elephant, and whale, and the smallest insect, with their sense of personality as real as ours, know nothing of their brains; yet *we* know that their mind belongs to a brain. If even we were ignorant of the external world, we should know there is something more than an immaterial soul without dimensions. For, though we could live for a time without our external senses, we could not live a few minutes without breathing. We should, as usual, internally feel our personality in that part of space where our head is. We should also internally feel the uneasiness arising from want of breath at a distance from this—in the part of space where our lungs are. We should be compelled to will a motion to remove this uneasy sensation. All this must inform us of matter. Nay, could we live without breath,—mere heads, since the head might ache in different parts, we should have internal evidence of extension. When Lord Brougham reminds us that we learn the existence of matter only by our minds, he should remember that we are not conscious of our existence till matter makes an impression upon us. The existence of mind as a property of peculiarly arranged and circumstanced matter was fully proved before, and therefore these considerations, like every other fact, harmonise with the account; and the doctrine of the existence of mind, independently of matter, indicates a want of modern knowledge and involves us in endless absurdity. Its studied display usually proceeds in our profession from rank hypocrisy and malice, as though a materialist may not be a devout Christian, and these pharisees say aloud, "I thank thee, Lord, that I am not as other men are — even as this materialist." I agree with the early Christians and Mr. Carmichael (*An Essay on such Physical Considerations as are connected with Man's ultimate Destination, &c.*, by Andrew Carmichael, M.R.I.A. Dublin, 1830.), that, as all nature is one whole, all other created beings are also organised. They and we are in but one spot at a time, and can move from one spot to another: what does so, cannot be else than matter and a property of matter. I consider this alone a proof that we possess no such imaginary thing as an immaterial soul. A masterly exposure of Lord Brougham's strange misstatements and sophisms on the subject of materialism will be found in *Observations on the Discourse of Natural Theology by Henry Lord Brougham*; by Thomas Wallace, Esq. LL.D.

his organ or seat;" of "phantasie or imagination, which some call *estimative* or *cogitative*," "his *organ* is the middle cell of the

one of his Majesty's Councillors in Ireland. London, 1835. An equally able and very learned exposure of the innumerable literary errors of this unfortunate book is contained in a work which must delight every man of education, and from which I have gained much information, — *Natural Theology considered with Reference to Lord Brougham's Discourse on that Subject*; by Thomas Turton, D.D., Regius Professor of Divinity in the University of Cambridge, and Dean of Peterborough. Cambridge, 1836. The Creator is a distinct being, to whom there is nothing "simile aut secundum," whose essence is incommunicable; and no created being has His attributes, though we speak of the Divine Mind. He is every where — has always existed — will always exist — and orders and sustains all things. His nature is past finding out; and, therefore, to attempt to conceive His nature, or to speak of Him except as speaking of His works and laws, is vain — and to think the highest created beings even approach His nature is absurd. In the words of Mr. Carmichael, — "There is no spirit in the universe but His incommunicable essence."

If Lord Brougham is deeply in error when he calls, as he does, the insensible change of particles during life "an entire destruction of the body," — "the body's death" and "dissolution," though organisation and life have not experienced the intermission of a moment, he is equally wrong when he derives a proof of the existence of something immaterial from the invariableness of our consciousness of identity. Not only does our memory often fail us, so that we cannot say whether we did or said certain things which others know was the fact; not only are we continually deceived in dreams, as having said and done what never was the fact, so that, as Mr. Wallace remarks, we frequently exclaim, "Did I really do so and so, or did I only dream it?" but insane people daily believe themselves to be others; and, after violent affections of the brain, people not unfrequently forget who they are, and believe themselves to be other persons. (See Gall, l. c. 8vo. t. iii. p. 122. sqq.) Nay, cases occur in which a man has the consciousness of two persons. As the brain, like all other organs of animal life, is double, and the operations of the two halves of the brain proceed like one, just as the double impressions on the eyes and ears are known only as one, so one side of the brain is sometimes diseased or injured to even a great amount, without impairment of the mind. But if their action is rendered discordant — not the action of one arrested, but thrown out of harmony with the other — or if they act alternately, we have the phenomena of two states of consciousness. "One of Gall's friends, a physician," says Dr. Spurzheim, "often complained that he could not think with the left side of his head; the right side was one inch higher than the left. Gall attended a gentleman who for three years heard peasants insulting him on his left side. He commonly discerned his derangement, and rectified his error; but if he took a little too much wine, or had a fit of fever, he always imagined there were voices abusing him. Tiedemann mentions a certain Moor who was alienated on one side of his brain, and observed his madness with the other.

"All monomaniacs have a complicated consciousnees. I saw in Dublin a lunatic who fancied himself the Duke of Wellington. He thought to have com-

brain;" and of memory, "his seat and *organ*, the back part of the brain."[t] This was the account of the faculties given by Arabian

manded in Spain, and to have gained the battle of Waterloo! yet at the same time he was a clever and excellent servant, did his service at table and in the house with great propriety. I saw him handing round at a table, where there was a large party, every thing with perfect order and decency, so that no guest could suspect his aberration.

"There are other sorts of remarkable cases which prove that consciousness is not always single. Mr. Combe (*System of Phrenology*, p. 108.) quotes from the *Medical Repository*, the case of a Miss R., in the United States, who naturally possessed a very good constitution, and arrived at adult age without having it impaired by disease. She possessed an excellent capacity, and enjoyed fair opportunities to acquire knowledge. Besides the domestic arts and social attainments, she had improved her mind by reading and conversation, and was versed in penmanship. Her memory was capacious, and stored with a copious stock of ideas. Unexpectedly, and without any forewarning, she fell into a profound sleep, which continued several hours beyond the ordinary term. On waking she was discovered to have lost every trait of acquired knowledge. Her memory was a tabula rasa. All vestiges both of words and things were obliterated and gone. It was found necessary for her to learn every thing again. She even acquired, by new efforts, the art of spelling, reading, writing, and calculating, and gradually became acquainted with the persons and objects around, like a being for the first time brought into the world. In these exercises she made considerable proficiency. But after a few months another fit of somnolency invaded her. On rousing from it, she found herself restored to the state she was before the first paroxysm, but was wholly ignorant of every event and occurrence that had befallen her afterwards. The former condition of her existence she called the old state, and the latter the new state; and she is as unconscious of her double character as two distinct persons are of their respective natures. During four years and upwards, she had undergone periodical transitions from one of these states to another. The alterations were always consequent upon a long and sound sleep. In her old state she possessed all her original knowledge; in her new state, only what she acquired since. If a gentleman or lady be introduced to her in the old state, or *vice versâ*, and so of all other matters, to know them satisfactorily, she must learn them in both states. In the old state she possesses fine powers of penmanship, while in the new she writes a poor awkward hand; having not had time or means to become expert. In January, 1816, both the lady and her family were able to conduct affairs without embarrassment. By quickly knowing whether she is in the old or new state, they regulate their intercourse, and govern themselves accordingly. The Rev. Timothy Alden of Meadville has drawn up a history of this curious case.

"I know the history of a noble family where a son had similar fits, accom-

[t] *Anatomy of Melancholy*, P. i. S. 1. Mem. 2. Subs. 7.

authors, as Gall remarks[u], and repeated with little variation, by the European writers of the middle ages." In the 13th century,

panied by a special memory; so that consciousness was double, one for the ordinary state, and the other for the fits.

"Dr. Devan read to the Royal Society of Edinburgh, in February, 1822, the history of a case, observed by Dr. Dyer of Aberdeen, in a girl, 16 years old, which lasted from 2d March to 11th June, 1815. The first symptom was an uncommon propensity to fall asleep in the evenings. This was followed by the habit of talking in her sleep on those occasions. One evening she fell asleep in this manner: imagining herself an episcopal clergyman, she went through the ceremony of baptising three children, and gave an appropriate prayer. Her mistress shook her by the shoulders, on which she awoke, and appeared unconscious of every thing, except that she had fallen asleep, of which she showed herself ashamed. She sometimes dressed herself and the children while in this state, or, as Miss L. called it, 'dead asleep;' answered questions put to her in such a manner as to show that she understood the question; but the answers were often, though not always, incongruous. One day in this state she sat at breakfast, with perfect correctness, with her eyes shut. She afterwards awoke with the child on her knees, and wondered how she got on her clothes. Sometimes the cold air awakened her; at other times she was seized with the affection whilst walking out with the children. She sang a hymn delightfully in this state; and, from a comparison which Dr. Dyer had an opportunity of making, it appeared incomparably better done than she could accomplish when awake. In the mean time a still more singular and interesting symptom began to make its appearance. The circumstances which occurred during the paroxysm were completely forgotten by her when the paroxysms were over, but were perfectly remarked during subsequent paroxysms. Her mistress said, that when in this stupor, on subsequent occasions, she told her what was said to her on the evening when she baptised the children. A depraved fellow servant, understanding that she wholly forgot every transaction that occurred during the fit, clandestinely introduced a young man into the house, who treated her with the utmost rudeness, whilst her fellow servant stopped her mouth with the bed-clothes, and otherwise overpowered a vigorous resistance which was made by her even during the influence of her complaint. Next day she had not the slightest recollection even of that transaction; nor did any person interested in her welfare know of it for several days, till she was in one of her paroxysms, when she related the whole fact to her mother. Next Sunday she was taken to church by her mistress while the paroxysm was on her. She shed tears during the sermon, particularly during the account given of the execution of three young men at Edinburgh, who had described, in their dying declarations, the dangerous steps with which

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[u] 4to. vol. ii. p. 358., 8vo. t. ii. p. 353. See Avicenna, l. i. sect. 1. doctr. 6. cap. v. p. 25.

a head divided into regions according to these opinions was designed by Albert the Great, Bishop of Ratisbon[x]; and another was published by Petrus Montagnana, in 1491.[y] One was published at Venice, in 1562, by Ludovico Dolce, a Venetian, in a work upon strengthening and preserving memory[z]; and another at Bologna, in 1670, in a work styled *Apologia Fisonomica*, by

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their career of vice and infamy took its commencement. When she returned home, she recovered in a quarter of an hour, was quite amazed at the questions put to her about the church sermon, and denied that she had been to any such place; but next night, on being taken ill, she mentioned that she had been at church, repeated the words of the text, and, in Dr. Dyer's hearing, gave an accurate account of the tragical narrative of the three young men, by which her feelings had been so powerfully affected.

"The same phenomena present themselves when in the state of somnambulism produced by animal magnetism. It has been repeatedly observed that some magnetised persons acquire a new consciousness and memory during their magnetic sleep. When this state has subsided, all that passed in it is obliterated, and the recollection of the ordinary state is restored. If the magnetic sleep is recalled again, the memory of the circumstances which occurred in that state is restored, so that the individuals may be said to live in a state of divided or double consciousness." (Dr. Spurzheim, *Phren.* Am. ed. p. 78. sqq.) See Gall on Personality (*moi*), 8vo. t. ii. p. 401. sqq.

[x] In the *Tesorretto* of Brunetto Latini, the preceptor of Dante, published in that century, the doctrine is taught in rhyme:—

Nel capo son tre celle,
Ed io dirò di quelle,
Davanti è lo intelletto
E la forza d' apprendere
Quello che puote intendere.
In mezzo è la ragione
E la discrezione
Che scherne buono e male.
E lo terno e l' iguale
Dirietro sta con gloria
La valente memoria,
Che ricordo e retiene
Quello ch' in essa viene.

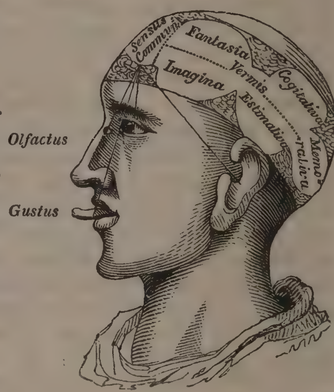
[y] Gall, 4to. vol. ii. p. 358. sq., 8vo. t. ii. p. 354. sq., where as many historical details are given as the greatest detractor from Gall's originality could wish.

[z] A friend presented me with this book:—*Dialogo di* M. Ludovico Dolce, *Nel quale si ragiona del modo di accrescere e conservare la memoria.* In Venetia.

Ghiradelli Bolognonese. In the British Museum I have seen a chart of the universe and the elements of all sciences, and in it a large head so delineated is conspicuous. It was published at Rome so late as 1632, and, what is singular, engraved at Antwerp by one Theodore Galleus, and the head is really a good family likeness of Dr. Gall, who, however, was born at Tiefenbrunn in Suabia, between Stuttgard and the Rhine, March 9. 1758.[a]

[a] Notice Historique sur le Docteur Gall, par M. Fossati, M.D. *Journal de la Société Phrénologique de Paris*, t. i. 1832.

It is remarkable that Aristotle, in his *Physiognomy*, though he gives a number of ridiculous signs of character from the face and numerous parts of the body, gives three only from the cranium; but that these are in strict accordance with the phrenology of Gall, who admitted of no deduction of intellectual or moral character from the developments of the face, but from those of the cranium only.* "Those who have a large head, are sagacious — are like dogs; those who have a small head, are stupid — are like asses; those who have a conical head, have no shame — are like birds with curved claws."



Head given by Dolce, 1562. It is copied into the *Edin. Phrenolog. Journ.* vol. ii. No. 7.

Μεγάλην οἱ τὴν κεφαλὴν ἔχοντες, αἰσθητικοί· ἀναφέρεται ἐπὶ τοὺς κύνας· οἱ δὲ μικρὰν, ἀναίσθητοι· ἀναφέρεται ἐπὶ τοὺς ὄνους. οἱ τὰς κεφαλὰς φοξοὶ, ἀναιδεῖς· ἀναφέρεται ἐπὶ τοὺς γαμψώνυχας.— *De Physiognomiâ*, cap. vi.

It is no less remarkable that one of each of these points is spoken of by each of the three greatest poets.

Milton distinguishes man from Eve and all the other beings in Eden, above whom he was intended to rule through the force of intellect, by his spacious forehead:

> "His fair *large front* and eye sublime declare
> Absolute rule." *Paradise Lost*, b. iv.

* l. c. 4to. vol. iv. p. 234. sqq., 8vo. t. v. p. 429. sqq. He of course allows pathognomy, or the art of judging of the state of the feelings by the expression of the countenance in action, to be real; and he mentions a number of curious facts illustrative of the coincidence of pathognomy with the seat of the organs. His original genius is very conspicuous on this subject.

It is, however, more than probable that the different parts of the brain have different offices. Its faculties are so various, that it is impossible to imagine them possessed by the same portion. The faculty for melody is perfectly different from the love of offspring. If to suppose all parts of the brain are organs for all faculties is difficult, the difficulty appears greater on reflecting that in that case the whole brain would be concerned in every act and feeling, or, if the whole brain is not thus constantly at work at all things, that different parts would perform the very same offices at different times, each part working in every kind of mental act and feeling in its turn. Neither does the brain perform merely one thing, as the whole liver performs the secretion of merely one fluid — bile; nor is its structure the same throughout, like that of the liver.

The best authors hold that its various parts have various offices[b], and Gall *proves* that they have.

Shakspeare makes Caliban say —

> " I will have none on't: we shall lose our time,
> And all be turned to barnacles, or to apes
> With foreheads *villainous* low. *Tempest*, Act iv. sc. 1.

Homer gives the basest fellow who went to Troy, a conical head — a miserable development of the seat of the moral sentiments: —

> Θερσίτης . . .
> . . . αἴσχιστος δέ ἀνὴρ ὑπὸ Ἴλιον ἦλθε.
> Φοξὸς ἔην κεφαλὴν.
>
> *Ilias*, B.

[b] " The brain is a very complicated organ," says Bonnet, " or rather an *assemblage of very different organs.*" (*Palingénésie*, t. i. p. 334.) Tissot contends that *every* perception has *different* fibres. (*Œuvres*, t. iii. p. 33.) Cuvier says, that " *certain* parts of the brain in all classes of animals are large or small according to certain qualities of the animals." (*Anatomie Comparée*, t. ii.) Sömmerring trusts that we shall one day find the *particular seats of the different* orders of *ideas*. " Let the timid, therefore, take courage," says Dr. Georget, in his admirable work upon the nervous system, " and, after the example of such high authorities, fear not to commit the unpardonable crime of innovation, of passing for cranioscopists, by admitting the plurality of the faculties and mental organs of the brain, or at least by daring to examine the subject." (*De la Physiologie du Système Nerveux, et specialement du Cerveau*, t. i. p. 126.) Gall's successful reply to some very unjust observations made in this work, will be found in his 8vo. edit. t. v. p. 488. sqq. Dr. Vimont repeats these, apparently in ignorance that Gall had fully replied in his small work; and censures Gall for having incorrectly said that Bonnet considered every cerebral fibre as having a distinct function. Now Bonnet's words really are, — " I thus consider every

If the old course, recommended by Mr. Dugald Stewart, of investigating the mind by attending to the subjects of our own consciousness, had been persevered in, the science of mind would have remained stationary for ever.[c] Our powers and feelings are distributed in such various degrees, and the external circumstances which have acted upon them are so various, that every man, judging from himself only, would draw up a different account of the human mind; as different from the attempts of all others, as the representations of the human face and head would be, if every painter were to execute his own likeness only. The account would be as inaccurate as if an individual were to determine the bodily powers and susceptibilities of the operation of agents by his own. Unquestionably much must be learned by observing the workings of our minds, and much can be learned

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sensible fibre as a very little organ with its own functions." "The brain contains a prodigious number of organs *infinitely small*, appropriated to sentiment and thought."

[c] Although Mr. Dugald Stewart declares that in his own inquiries he has "aimed at nothing more than to ascertain, in the first place, the laws of our constitution, as far as they can be discovered by attention to the subjects of our own consciousness;" (*Essays*, Preliminary Dissertation, p. 2.) "that the whole of a philosopher's life, if he spends it to any purpose, is one continued series of experiments on his own faculties and powers;" (p. 40.) and that "the structure of the mind (whatever collateral aids may be derived from observing the varieties of genius in our fellow creatures) is accessible to those only who can retire into the deepest recesses of their own internal frame;" yet he adds, "even to those, presenting, along with the generic attributes of the race, many of the specific peculiarities of the individual," (*Elements*, vol. ii. p. 513.) and has really the following passages in the forty-second and forty-third pages of the *Essays*. — "To counterbalance the advantages which this science of mind lies under, in consequence of its slender stock of experiments, made directly and intentionally on the minds of our fellow creatures, human life exhibits to our observation a boundless variety, both of intellectual and moral phenomena, by a diligent study of which we may ascertain almost every point that we could wish to investigate, if we had experiments at our command." "Savage society, and all the different modes of civilisation; the different callings of individuals, whether liberal or mechanical; the prejudiced clown, the factitious man of fashion; the varying phases of character, from infancy to old age; the prodigies effected by human art, in all the objects around us, laws, government, commerce, religion; but above all, the records of thought preserved in those volumes which fill our libraries; — what are they but experiments, by which nature illustrates, for our instruction, on her own grand scale, the varied range of many intellectual faculties, and the omnipotence of education in fashioning the mind."

in no other way; just as we may learn much of the external form of the human body by looking at ourselves, and cannot learn what are the feelings of hunger and thirst, heat and cold, except from our own consciousness. But it is only by extensive observation of others, of different sexes, ages, races, education, occupations, and habits, in addition to the study of ourselves, that this knowledge is to be acquired. Nor would much progress have been made without the discovery — that strength of individual talent and disposition was associated with proportionate development of particular portions of the brain. By this remark, confirmed by the opposite observation of deficient development of the same portions of the brain being accompanied by deficiency of talent or disposition, the existence of particular faculties was firmly established; and indeed Gall discovered them by observing persons conspicuous in some mental points to have certain portions of the head extremely large. I did but allude to craniology while detailing Gall's account of the mind, because the arrangement may be perfectly accurate, although craniology be false; nor when speaking of the brain as the organ of the mind, because that fact also is independent of Gall's system. But, if the account of the mind, the use of the brain, and the development of the brain, generally observed by that of the cranium — by craniology, be now viewed together, they will all be seen mutually and beautifully to confirm each other.

Much ignorant invective, but no argument, has been written against the doctrine; nor a *single fact* adduced in opposition to it. We are presented with a simple statement — that constant strength of certain parts of the mind is accompanied by strong development of certain parts of the brain, and, *consequently*, of the skull, except in disease and old age; and deficient development of certain parts of the brain, and, *consequently*, of the skull, accompanied by deficient strength of certain parts of the mind. The truth must be ascertained, not by speculating, quibbling, and abusing, not by giving improper way to the lower feelings of our nature, but by observing whether this is the case; and every one has it in his power to make the necessary observations. Those who pretend to have facts to offer in objection, must first be so well acquainted with *craniology* as to be able to judge accurately of the development which they adduce, and have carefully ascertained the character and exact talents of the individual whom they fancy to be an exception. Yet accounts the most absurd, and the most remote from truth in

these particulars, are uttered and printed every day, even by those who assume the character of *scientific* men. Inquirers, however, must not expect always to find the converse of the statement verified, — to find strength of development always attended by strength of certain parts of the mind; nor deficiency of the manifestations of certain parts of the mind always attended by deficient development. Because the development of the head may arise from other causes than brain, or the quality of the brain may not be healthy; and, on the other hand, deficiency of the manifestations of a part of the mind may arise from mere want of excitement, or from disease. The head may be large, generally or locally, from fluid, morbid growth of bone, &c.; or the brain, though the cause of the size, may be of bad quality from original fault of structure, from subsequent disease, or from old age. But the existence of disease is generally known, and old age must be evident. Again, defective manifestations of a part of the mind from mere want of excitement rarely occurs except in regard to the intellectual powers; for external circumstances almost always exist around sufficient for the play of the feelings. Thus, although any phrenologist may always without fear assert positively of the head from constant positive exhibitions of the mind, and always fearlessly assert negatively of the mind from negative exhibitions of the head; he would not assert respecting the mind from positive exhibitions of the head, nor respecting the head from negative exhibitions of the mind, without certain provisions, viz. that the size of the head depends upon healthy brain, and the deficiency of mind arises from no want of excitement, or from disease. Yet, in the far greater number of instances, the development of the head agrees with the mind. In the greater number of those in which it does not, the probability of the want of agreement is evident; and in the rest, the phrenologist cannot be wrong, because he will never assert from positive development of the head, nor from negative manifestation of the mind. Even in unsoundness of mind, the character generally agrees with the development; the parts of the mind that may remain sound, generally manifest themselves according to the development of the head; and those faculties which are diseased, are usually excited in proportion to the development of the corresponding parts of the head.[d]

[d] Let the antiphrenologist get over the diagnosis of Gall in his visit to some Prussian prisons (l. c. 4to. vol. iv. p. 369. sqq., 8vo. t. vi. p. 476. sqq.), and of

The exact situation of the organs can be learnt from delineations or marked heads only. I shall therefore confine myself to Gall's general remarks. 1st. The organs of the faculties or qualities common to man and brutes, are placed in parts of the brain common to man and brutes, — at the inferior-posterior, the posterior-inferior, and inferior-anterior parts of the brain; *v. c.* of the instinct of propagation, the love of offspring, the instinct of self-defence, of appropriating, of stratagem, &c. 2dly. Those which belong to man exclusively, and form the barrier between man and brutes, are placed in parts of the brain not possessed by brutes, *viz.* the anterior-superior and superior-anterior of the front: *v. c.* of comparative sagacity, causality, wit, poetic talent, and the disposition to religious feelings. 3dly. The more indispensable a quality, or faculty, the nearer are its organs placed to the base of the brain, or median line. The first and most indispensable — the instinct of propagation — lies nearest the base; that of the love of offspring follows. The organ of the sense of localities is more indispensable than that of the sense of tones or numbers; accordingly the former is situated nearer the median line than the two latter. 4thly. The organs of fundamental qualities and faculties which mutually assist each other, are placed near to each other; *v. c.* the love of propagation and of offspring, of self-defence and the instinct to destroy life, of tones and numbers. 5thly. The organs of analogous fundamental qualities and faculties are equally placed near each other: *v. c.* the organs of the relations of places, colours, tones, and numbers are placed in the same line, as well as the organs of the superior faculties, and the organs of the inferior propensities.[e]

Although the arrangement of the organs is so beautiful, we must not imagine that Gall mapped out the head at pleasure, according to preconceived notions. He discovered one organ after another, just as it might happen, and marked down its situation and size upon the cranium; and after all left several spots

Mr. Combe, in his visit to the Richmond Lunatic Asylum, Dublin, and the prisons and lunatic asylums of Newcastle. (Dr. Combe *On Mental Derangement*: and *Ed. Phr. Journal*, No. xlvi.) On Idiotism with no defect of development, see Gall, l. c. 8vo. t. vi. p. 50.

[e] Gall, l. c. 4to. vol. iii. p. 78. sq., and 8vo. t. iii. p. 208. sqq. So much less have the writings of Gall than those of Dr. Spurzheim been studied in Edinburgh, that Mr. Scott published these two last principles as his own; and they thus stand, with great praise, in Mr. Combe's *System of Phrenology*, p. 534. sqq.

blank, which others have filled with faculties corresponding with those around. The organs are represented, in the engraved heads which he published, as so many prominences; because each is just as it showed itself to him in single instances where it was extraordinarily developed. This habit of representation for distinctness and fidelity of form and size, and that of speaking of individual parts as prominent, gave origin to the vulgar notion of bumps, and those ignorant views which still disgust us in persons who should know better. Often one organ became known to him situated very remotely from the organ last discovered. The set of organs discovered by him turned out as it is, and a strong argument is thus afforded of the truth of his system, He viewed a thousand times what he had remarked, before he was aware of the great general truths just mentioned.

"All must be struck," says he, "with the profound wisdom which shines forth in the arrangement and successive order of the organs. This connection is, in my eyes, one of the most important proofs of the truth of my discoveries. I defy those who attribute my determination of the fundamental faculties and of the seat of their organs to caprice or arbitrary choice, to possess a tenth part of the talent necessary for the most obscure presentiment of this beautiful arrangement; once discovered, it displays the hand of God, whom we cannot cease to adore with wonder increasing as his works become more disclosed to our eyes."[f]

[f] l. c. 8vo. t. iii. p. 210. sq. See also 4to. vol. iii. p. 80. Mr. Combe (l. c. p. 536.) presents these beautiful remarks as Mr. Scott's, with no other mention of Gall than that the *system* must thus be the work of nature, and not "of Drs. Gall and Spurzheim." Dr. S. divided all the faculties, after the ancients, into effective and intellectual; and the former again into propensities and sentiments; the latter into perceptive and reflective. (l. c. p. 131.) For this he has been said to have "infused philosophy and system into the facts brought to light by observation," (*Ed. Phr. Journ.* vol. v.) — to possess a power of arrangement which throws light upon every subject." (*Star of Brunswick*, quoted in his *Biography*, published at Boston, p. 99.) Gall, again, was declared to have no such powers of systematising. What is the truth? Gall disliked artificial systematic division and subdivision, and that justly. His very order of examining is as great a classification as nature will admit. His order was, "as much as possible, that which the Author of nature observes in the gradual *perfectionnement* of animals." (l. c. 4to. t. iii. p. vi.) Beyond the order which he followed in his writings, nothing could be done; and, as Mr. G. Combe truly says (*Preliminary Dissertation* to the *Phr. Journal*, p. 25.), "as soon as observation had brought to light the great body of facts, and the functions of

Gall followed this natural order of the faculties. "I conform to the order which exists in considering the inclinations or inferior

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losophy of the human mind presented itself almost spontaneously to view." Gall saw nothing satisfactory in Dr. S.'s classification. "The most natural and philosophical order," says Gall, "must be that which nature has observed in the successive arrangement of the cerebral parts. But M. Spurzheim begins by establishing new divisions of the faculties of the mind." "The philosophical spirit of M. Spurzheim shines in divisions, subdivisions, sub-subdivisions, &c.; and this is what he calls infusing more philosophy into the physiology of the brain, than I had the ambition of introducing. By these divisions he has imposed on himself a constraint which totally inverts the gradual succession of the organs. He is forced to jump from one region of the brain to another; from the disposition to theft, to destruction; from this to construction; from circumspection, to benevolence; from benevolence, by a great effort, to veneration; from supernaturality (he is using Spurzheim's terms), he comes to the external surface part of the forehead, thence to imitation; from imitation, to the external senses! Then he retires to the brain towards the frontal region — there again he treats every thing *péle-méle*, all in a manner opposite to nature; — a perfect monstrosity, which one would believe to be invented with the design of rendering the study impossible. The propensities and sentiments, and often the intellectual faculties, are so confounded together, that it is hardly possible to discover the characteristic signs which distinguish one from another. What more reason is there to place constructiveness among the propensities, than melody, benevolence, and imitation? Are not amativeness, philoprogenitiveness, inhabitiveness, attachment, courage, as much sentiments as self-love, love of approbation, veneration, &c.? In what sense are perseverance, circumspection, imitation, sentiments? With what propriety does he exclude imitation, wit, ideality or poetry, circumspection, secretiveness, constructiveness, from the intellectual faculties?"* Wit and imitation were originally placed by Dr. S. among the intellectual faculties, and then removed to the sentiments in later editions. The Feelings were divided into superior and inferior, and those common to brutes and man and those peculiar to man; and imitation was ranged with the superior and peculiar to man! but, no sooner has he done this, than he admits imitation to exist among many tribes of brutes! (*Phr.* Am. ed. vol. i. p. 257.) Wit, the organ of which is amidst the intellectual, he dislodges for mirthfulness, which he calls a superior sentiment *peculiar to man*, and given to "render him *merry and gay*"! — to be "as gay as a *lark*," however, I suppose, and "merry as a *kitten*." He forgets that *mirthfulness* always implies noise:"

"Far from all resort of mirth,
Save the cricket on the hearth."

His opinions on this faculty appear to me most extraordinary. In one of his works (*Essai Philosophique*), he classed benevolence with those peculiar to man;

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* l. c. 4to. vol. iii. p. xxvi. sqq. Dr. Vimont also exposes the faults of Dr. S.'s classification. (l. c. t. ii. p. 106. sqq.)

qualities; then those which have more and more nobleness; and end with the highest sentiment—that which leads us to reverence the divinity."[g]

in another allows it to brutes (*Phr.* Am. ed.); and, having subdivided sentiments into superior and inferior and finished the inferior, saying he has "gone over the affective faculties which are common to men and animals," he begins with the superior, and says the first (benevolence) "cannot be entirely denied" to brutes. (p. 222.) He arranges the five external senses with the intellectual faculties;—"the triumph of his new arrangement," as Gall severely terms it. Dr. S.'s classification had been devised and published ten years before by Bischoff. Yes; Dr. S., in all his works and editions, gives his arrangement without a hint that any one had classed the faculties before; whereas in the work already quoted (*Exposition de la Doctrine de Gall*, traduite de la seconde édition d'Allemand, 1806), Bischoff's division into three orders will be found,—the first containing the propensities and sentiments; the second, the perceptive faculties; and the third, the intellectual. Three faculties are in the second class, and one in the third, which Dr. S. puts in others; but he himself shifted some occasionally, and the difference is insignificant; and Dr. S.'s invariable silence as to this arrangement, while his own forms a conspicuous part of nearly all his books, is a fact in complete harmony with the rest of his conduct. "I conceive it possible to divide them" (the faculties), says Dr. S., "and to establish a new classification;" "and I established a new division of the mental operations." (*Phren.* Amer. edit. vol. i. p. 129. sq.) In his first London edition, he most innocently says, "I am now led to think that the objects which are still to be added to our large work must assume a more scientific arrangement, and be considered in a more philosophic manner than Dr. Gall has been accustomed to do in his lectures." (p. vii.) Then follows his most trifling variety of Bischoff's arrangement, to which he no where alludes, though he proves his acquaintance with the book in his notes to the *Foreign Quarterly*, p. 62. The following is Gall's opinion of classification:—"Every one may arrange the moral qualities and intellectual faculties according to his own views of them. They may be divided into sentiments, propensities, talents, intellectual faculties;—pride, for example, and vanity, would be sentiments; the instinct of propagation, the love of offspring, propensities; music, mechanics, would be talents; comparative sagacity would belong to the intellectual faculties. But there is frequently embarrassment in rigorously fixing the bounds of each division. The intellectual faculties and talents, when their organs are very active, manifest themselves with desire, propensity, and passion; the sentiments and propensities have also their judgment, their taste, their imagination, their memory and recollection. The division into qualities and faculties common to man and brutes, and faculties and qualities peculiar to man, is, I confess, of great value in a philosophic point of view; but," "when the most careful observer dares not decide where the faculties of the brute cease, and those of man begin, this division cannot be considered satisfactory. The best division, in my opinion, is into fundamental qua-

[g] l. c. 8vo. t. iii. p. 224.; also, 4to. vol. iii. p. 85.

If Gall's is the only satisfactory account of the mental faculties, and to me it certainly appears so, this alone is a proof of

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lities or faculties, and general attributes of these qualities and faculties. In this division, the fruits of the labours of my predecessors are preserved, and, while we avail ourselves of them, we establish the true theory of the primitive and fundamental instincts, qualities, and faculties of man and brutes." (l. c. 4to. t. iv. p. 344. sq., 8vo. vol. vi. p. 433. sq.)

Dr. Spurzheim, in his fondness for changing his names, his arrangement, and his numbering of the organs, introduced confusion without advancing knowledge. To prove his speculative spirit, I may mention that, instead of giving the origin of any of his asserted discoveries, as Gall did, and adding a host of examples, he tells us, in regard to the organ of inhabitiveness, only that a gentleman much attached to his house had a particular spot of his head hotter than any other; and in regard to the organs of hope, marvellousness, conscientiousness, size, weight, order, time, he neither tells how he discovered them, nor adduces a single proof. Gall was too much of a philosopher to wish others to examine a mere assertion.

But, in regard to all the organs discovered by Gall, except that of colour, Dr. S. gives the circumstances which led to the discovery, and a certain number of individual facts; though but a very small number of those related by Gall. "He has changed the names," says Gall, "but treated the organs according to my principles; yet in so hasty and feeble a manner, that this part of my doctrine would be deplorable, if it were not established on a better foundation." (l. c. 4to. vol. iii. Preface; a part which every body should read, for its exposure and demolition of Dr. S.'s unjust and weak attempts.) His own alleged discoveries may be real; but the remarkable circumstance I have mentioned tends to create a suspicion that he reasoned himself into a belief of certain faculties, and gave them localities according to their nature; having learnt from Gall where "perceptive" and where "reflective faculties," where "sentiments" and where "propensities," to use his own language, reside. Localisation, after Gall's discoveries, was easy, especially as Gall had not mapped out the whole head, but left blanks where he possessed no facts.

He changed even the situation and extent of organs in his last plate. The space allotted by him to marvellousness was originally between wit, imitation, hope, and ideality; now it is more than twice its former size, and placed between these four and veneration. Covetiveness was placed by Gall, and admitted by Dr. Spurzheim, before cunning and under ideality; now it is over cunning, and between ideality and cautiousness. Ideality in his first edition was chiefly above covetiveness and before circumspection; now it is above constructiveness, and a large organ stands between it and covetiveness. Yet he declares, that, "though marked busts or plates may be *numbered* differently, the places of the respective organs, once considered as established, have never been altered." (*Phr.* Amer. ed. vol. i. p. 136.) If he is right as to the new situation of the organ of covetiveness, all the observations which led Gall to its discovery, and originally convinced Dr. S., fall to the ground. Dr. S., in the *Notes* (p. 62.), says, "that he has been occupied for three years with showing the regularity of the cerebral portions, and with specifying the individual organs

the truth of his organology. For such an account could not have resulted from imagination; and observation, unaided by reference

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and their boundaries;" "an additional discovery, of which Dr. Gall died in ignorance." Yet Gall, in both his works, refers to the individual convolutions which he regards as the organs of the individual faculties. Dr. S., in these (*Notes* p. 63.), then says, "that it was he himself who directed phrenologists to attend to the individual regions of the head, in reference to the three lobes of the brain, and to the three regions of the animal propensities, the human sentiments (among which he puts some not exclusively human), and intellectual faculties (but he admits the five senses among these), rather than to the protuberances and depressions, to which Dr. Gall attached himself almost exclusively." Now Gall over and over again speaks of the development of regions (l. c. 4to. vol. iii. p. 85., 8vo. t. iii. p. 221. sqq.; 4to. vol. ii. p. 400. sq., 8vo. t. ii. p. 423. sqq.; 4to. vol. iv. p. 13. sq., 8vo. t. iv. p. 378.; 4to. vol. iv. p. 161. sq., 8vo. t. v. p. 191. sqq.), and expressly advises that the size of the whole head should be first observed; then that of the frontal, occipital, lateral, and sincipital regions; and lastly the subdivisions of these regions; and "it will be soon found," says he, "that the best developed organs do not form any of the bumps of the antiphrenological buffoons, nor prominences like an egg or your fist." (l. c. 8vo. t. iii. p. 221. sqq.)

Dr. S. also says (*Notes*, p. 63.), that "Gall mostly confined himself to the comparison of talents, character, and certain modes of acting, with individual cerebral portions;" and I have heard it often asserted that we owe to Dr. S. only our knowledge of the mutual influence of organs. But Gall insisted strongly upon this, though he left the endless working out of the self-evident effects of the varied proportions of organs to us all. (l. c. 4to. vol. iii. p. 192., 8vo. t. iv. p. 243.; 4to. vol. iii. p. 298. sq., 8vo. t. iv. p. 253. sq.; 4to. vol. iv. p. 256. sq., 8vo. t. v. p. 374. sq., 8vo. t. ii. p. 318. sq.) So, in regard to mania, the substance of all that Dr. S. has written upon it may be found in Gall. (l. c. 4to. vol. ii. iii. iv., 8vo. t. i. p. 370. sq., and t. i. ii. iii. iv. v. *passim.*)

He illustrated and applied Gall's philosophy on the subject of morals, education, &c.; but, when he is satisfactory, I see nothing more than is to be found, expressed far more concisely, powerfully, and elegantly in the writings of Gall.

The merit of Dr. Spurzheim was that of an able and persevering pupil of Gall. It is possible that, having worked under Gall's direction so long, after he left his great master he discovered a mechanical anatomical point or two—though I know not that he did. It is possible that he discovered the organs of three faculties, which Gall believed to exist — time, and order, and conscientiousness. He had, however, only to look for the spaces left vacant by Gall among the organs of the perceptive faculties to locate time and order; and he no doubt remembered, as all Gall's acquaintance do, that Gall always said that the organ of time would be found close to that of tune, and had actually left a space there. It is possible, that he established a few more faculties and their organs — weight, size, and hope. But I am not yet certain of the two former. Hope I do not believe to be a primitive faculty. I believe, with Gall, that every

to development, never produced much that is satisfactory in metaphysics. It was in fact derived from studying the organisation.

faculty desires its gratification, and that its prospect of this, or hope, is regulated by the degree of circumspection and of the intellectual faculties.* He of course had only to place conscientiousness and hope in the spaces left vacant by Gall among the moral sentiments. In regard to marvellousness, Gall had assigned that part of the brain to the disposition to see visions; but regarded these as only an excess of activity of some fundamental power, and had often discussed with Dr. S. the possibility of a faculty for wonder; though he refrained from publishing mere speculations. (l. c. 4to. t. iii. p. xxiv., 8vo. vol. v. p. 345.) Then, as to the organ of inhabitiveness, we must remember that Gall left the space vacant, and pointed out that animals inclined to inhabit high places had the part immediately above it large; — that Gall taught the existence of a faculty inclining to particular habitation, and placed that faculty in the region where Dr. Spurzheim has fixed his organ of inhabitiveness. If Dr. S. is correct, he has cleared up what Gall considered unsettled. But Dr. S. could not consider himself certain, as in his last edition he begged phrenologists to make observations on the point; and the Edinburgh phrenologists actually give to that part the faculty of what they call concentrativeness — the faculty of "maintaining two or more powers in simultaneous and combined activity, so that they may be directed towards one object." (Dr. S. *Phr.*, Amer. ed. vol. i. p. 169.) They attempt to reconcile matters by seeing no inconsistency in both views. To this Dr. S. cannot agree, and he satirically says, that, with all possible deference to Mr. Combe's acuteness and greater development of the organ of concentrativeness, he cannot believe the inclination to inhabit a particular spot, and the power of keeping two or more faculties in simultaneous action, to be the same. The publication of such speculations, such deviations from rigid observation — from true inductive philosophy — it was that distressed Gall in both Dr. S. and some Edinburgh phrenologists.

Dr. S. differed from Gall on certain points regarding the various faculties which he admitted; but I confess that, so far from improvements, I think that his opinions in general are unsatisfactory or incorrect, and exhibit subtlety rather than depth, and an immeasurably less powerful and philosophic mind than that

* "Most authors confound the affections with the passions. By passion I mean the highest degree of voluntary or involuntary activity of any fundamental force. Every passion implies a particular organ; but this organ produces the passion of its function, only when at the maximum of its activity. It is different with the affections. In the passions, the organs are active, exalted in their fundamental function; in the affections, on the contrary, the organs are passive, modified, seized in a particular manner, agreeable or disagreeable. Shame, fear, anguish, sorrow, despair, jealousy, anger, joy, ecstasy, &c., are involuntary sensations, passive seizures, either of our nervous system, of one organ, or of the whole of the brain. There consequently can be no peculiar organ for joy, for sorrow, for despair or discouragement, for *hope*, nor for any affection whatever." (Gall, l. c. 8vo. t. vi. p. 431. sq.)

He never once allowed himself to speculate, having early learnt the fallacy of *à priori* reasoning; but abandoned himself entirely to observation.

Gall discovered each organ and its faculty either by meeting with individuals very remarkable for the latter, so that he was led to examine their heads; or by noticing a peculiarity of formation in the head which induced him to ascertain their talents and character. He did not examine remarkable persons according to the views entertained of the faculties by metaphysicians; but according to points in which the world at large pronounced them remarkable,—accordingly as they were courageous, avaricious, kind-hearted, or excelled as poets, mimics, linguists, philosophers. He would never have made his discoveries, had he not met with persons remarkable in these respects. Sometimes the relation between the remarkable faculty or quality and the local development was tolerably obvious, but generally he had to make numerous observations before he found himself right. After having found two individuals remarkable in the same point of character, and cast their heads, he sometimes examined the casts daily for months before he could discover the precise spot in which they agreed. The discovery being now made, a good organologist will give judgments upon character which must astonish, and incontestably prove the truth of phrenology; but the difficulty of making the discovery when all was utter darkness must have been extreme.[h] The indefatigable industry of Gall, during the whole of a long life, constantly observing all persons he met with, and searching after all who were in any mental respect remark-

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of Gall. Dr. Lélut has just published a work which he calls *Qu'est ce que la Phrénologie?* and says that Gall's psychological doctrine is "souvent heureusement corrigée, mais quelquefois aussi gâtée par Spurzheim hı par la phrénologie." (p. 398.) Yet he mentions ten points of deterioration by Dr. S., and but four of improvement, and among these four, two appear to me improvements only because Dr. Lélut is in error as to Gall's opinions.

[h] "I had innumerable difficulties to overcome; as long as a quality or faculty, or even its organ, was not discovered, I was in the deepest ignorance. I never had the slightest idea of what I should at length discover, nor where I should find the organ. A large number of facts was requisite to put me in their way. How often have I not been obliged to reject, after years, what had appeared to me well established! Often I was tempted to give up all inquiries of this nature, and to declare, with my predecessors, that it is impossible to discover the traces of the operations of the soul." (l. c. 4to. vol. iii. p. 77. sq. See also 8vo. t. iii. p. 206. sqq.)

able, travelling as he did to most of the prisons, mad-houses, and hospitals of the Continent; examining the habits and heads of brutes innumerable for comparison; and engaging M. Niklas, Dr. Spurzheim, and others, for a pecuniary consideration, to work under him and examine points for him, in the way of reading, dissecting, casting, moulding, and observing living persons, is astonishing [k]; and the success and importance of his researches will, I am satisfied, ensure him a place among the greatest names of the human race, although, like every other great discoverer and benefactor, he has been loaded with ridicule and abuse.[l] His great anatomical discoveries were derided, and, when this was possible no longer, given falsely to his predecessors, or contemporaries, or have been given even to later writers. Some have been announced by others, lately, as new, and are even contended for by different individuals. Few anatomists and physiologists have any idea of the errors as to facts and of the poverty of argument displayed by Cuvier, Tiedemann, Pinel, Esquirol,

[k] l. c. 8vo. t. iii. p. 137. sqq. 172. sq. 206. sq.

[l] Mr. (now Lord) Jeffrey, in a violent article in his *Edinburgh Review* for 1815, after glancing at an English work by Dr. Spurzheim, wrote off-hand an article against it, and declared "the whole doctrines, anatomical, physiological, and physiognomical, to be a piece of thorough quackery from beginning to end,"—"there being nothing so impossible but *mountebanks* will undertake, nothing so incredible but they will affirm," — "that to enter on a particular refutation, would be to insult the understanding of readers," as Gall's opinion "on the *functions in general* of man, and on his intellectual faculties in particular, are a collection of mere absurdities, without truth, connection, or consistency; an incoherent rhapsody, which nothing could have induced any man to have presented to the public under a pretence of instructing them, but absolute insanity, gross ignorance, or matchless assurance." "Such is the trash," he continued, "the despicable trumpery, which men, calling themselves scientific inquirers, have the impudence gravely to present to physiologists of the nineteenth century as specimens of reasoning and induction." — A clergyman, afterwards chaplain to a Royal Hospital, and now a dignitary, at the same time wrote an article in a less violent strain in the *Quarterly Review*, in which he styled phrenology "sheer nonsense, and Dr. Spurzheim a fool." (No. xxv.) A year before they had called Gall "an ignorant and interested quack;" and *Blackwood's Magazine*, in April, 1817, foretold that "phrenology would be forgotten as soon as Dr. Spurzheim left Edinburgh:" just as, when Der Freischutz was first played in London, the *Literary Gazette*, which, like so many other learned periodicals, has always spurned phrenology, pronounced that, if the Germans were delighted with such music, they must be more easily satisfied than Englishmen; that it was "extremely ineffective;" and they "much doubted if there be a single air in it likely to become popular." (July 24. 1824. No. 392.)

Richerand, Carus, Rudolphi, Serres, &c., and would be amply repaid for the trouble of reading their exposure by Gall in various parts of his works, especially in his sixth octavo volume. Whoever knew him must have admired his profundity and candour, and the extent and variety of his knowledge, and been delighted with his perfect integrity and true philosophy of character, and the gentleness and elegance of his manners. [m]

[m] Nothing could demonstrate more the unsuspecting and kind nature of Gall than his affixing the name of Dr. Spurzheim with his own to his great work. He was the discoverer, and first published on his discoveries in 1798. He first lectured in 1796, when 40 years of age; Dr. S. being but 20 and a student. He continued to lecture on his discoveries till 1802, when the absurdity of Austria forbade all lectures in Vienna without permission. Gall knew the measure was levelled at himself; and, scorning to ask permission, left Vienna. Dr. S., who was tutor in the family of a nobleman attended by Gall, after having finished his medical studies, had become one of Gall's pupils, and was the only one among them all who was willing to leave Vienna with him. Gall saw his good intellectual development and his firmness, and engaged him as his secretary, dissector, &c. Though we all know how beautifully Dr. S. dissected the brain, Gall assured me that he was very long in teaching Dr. S. to dissect it; and that Dr. S.'s clumsiness cost him no little in broken casts, models, &c. Dr. S. thus worked hard at phrenology: but he worked under Gall's direction, and Gall smiled at the idea that two persons, the one twenty years older than the other, and the entire discoverer of a subject on which he had laboured for thirty years, and paying the other for his labour, could work at the same points, unless the one were directed by the other, — not at different branches of the same subject; and especially he smiled at Dr. S.'s having made discoveries, except as far as he found things which he was directed by Gall to ascertain. The whole work was Gall's. Every line, he informed me, was his sole composition. The very style shows this. The work is clear, flowing, full, at once rigidly philosophical and rich with profound thoughts and glowing illustrations. I never take it up without finding something fresh, and feeling that I am with one of that band of mighty minds to which Bacon, Milton, Shakspeare, &c. belonged. It speaks for itself and is totally different from Dr. S.'s; and yet in the preface, p. xlii, he was so good to Dr. S. as to mention the very composition and diction in the plural number, though self-evidently referrible in all cases to no more than one person. He conceived that all Europe knew him as the author of the discoveries; and he wished to be of service to Dr. S., who had shown good abilities and been industrious; and who, being twenty years younger, would, he hoped, prosecute and spread the science after his death. They were coming shortly to England together, when, one day, Dr. S. said he himself was going alone to England; and he actually left Gall in a week, it turning out that he had been learning English with this view in Gall's house, without Gall's knowledge, for six months. Gall, therefore, affixed Dr. S.'s name no longer with his own in the title-page: but the work went on, as when Dr. S. was with Gall. The second,

Whoever acquires sufficient knowledge of the subject to make observations for himself will soon find the shape of the skull to

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third, and fourth volumes were completed, in the same style, with the name of Gall only; and what had been printed in the joint names of Gall and Dr. S. was undistinguishable from the rest, was evidently the production of the same genius, and remained the sole property of Gall, and the disappearance of Dr. S.'s name from it proved that it was none of his. In the remaining parts with only Gall's name, was done all that had been promised in the first volume which bore both names. Gall, in the rest of his work, always referred to the former parts, which bore Dr. S.'s name also, as solely his own. — "Tout ce que *j'ai* dit dans le premier volume," &c. "Dans le premier volume de cet ouvrage, *j'ai* exposé l'anatomie," &c. "Dans le second volume *j'ai* abordé le but principal de *mes* recherches." (4to. vol. ii. p. 251., iii. p. xv.) In his preface to the 8vo edition he says, "It is three years since the publication of *my* great work on the anatomy and physiology of the brain was finished (4 vols. fol. and 4 vols. 4to.), now to be had of the *author*, and at N. Maze's, bookseller, No. 4. Git-le-cœur Street. He then informs his readers, that, though *he* had thought it necessary to publish a work worthy of the object, he had been requested on all sides to publish an edition of it which might be within the means of every body. At p. 73. he refers to the first volume "de *mon* grand ouvrage," and so in numerous other parts (ii. 432., v. 502., vi. 165., iii. 70.). He then recapitulates all the anatomy of the large work, and all the physiology, as his own, without thinking of mentioning Dr. S.'s name any more than Dr. Magendie's. (l. c. t. vi. p. 497. sqq.) On this Dr. S. never ventured to remark. Gall thenceforth generally used the words *I* and *my*, except when Dr. S. had witnessed any thing with him. For Dr. S., being engaged to travel with him, after he had brought his science to such fulness that he determined to lecture upon it in various countries, necessarily, he says, made "une grande partie de mes observations en commun avec moi." (8vo. t. i. p. vii.) Even in the preface to the first volume, he spoke of all the discoveries, anatomical and physiological, as having long been made; but that, rather than yield to a desire of fame, he had preferred allowing others to publish them, and presenting a work to the public which should be supported by "more abundant observations and more positive results;" — a remark agreeing with his assertion to me, that, after he had engaged Dr. S., he only collected more facts in illustration of his discoveries and made additions which were mere shades of knowledge. Dr. Georget, in his book referred to p. 371. *suprà*, published in Paris soon after the appearance of the great work, speaks of it as Gall's, and addresses his remarks to Gall. (Gall, 8vo. t. v. p. 448. sqq.) I formerly exhibited Dr. S.'s injustice to Gall in regard to anatomy; he is equally unjust in regard to physiology. While he is obliged to detail Gall's discoveries and acknowledge him the founder, he inconsistently says, "Gall has the great merit of having *begun our* phrenological discoveries." "He had pointed out *many* relations which exist between various talents and characters of man and instincts of animals, and certain cerebral parts, before I was so happy as to become acquainted with him." (*Notes* to the article in the *Foreign Quar-*

be as various as character and countenance, and will have hourly amusement both in remarking the relation between intellectual

terly, p. 60.) Gall had only begun! he had begun *our* researches! he had pointed out many relations! Here is enough, again, to stamp Dr. S.'s character for shortsightedness and effrontery, through his insane ambition. "*Plusieurs relations!* vingt-sept facultés!" says Dr. Vimont: "Ce mot *quelques* ne me paroit pas seulement une injustice; c'est une maladresse; car il resulte des faits avancés dans le corps de l'ouvrage de Spurzheim que Gall avoit déjà découvert, par la voie expérimentale, le nombre de facultés que je viens de citer. La prétention donc de Spurzheim au titre de fondateur nous paroit tout-à-fait injuste." (l. c. vol. ii. p. 53.)

Although Madame Gall, being well acquainted with all the affair, freely, like a good wife, bestowed upon Dr. S. the titles of *jésuite, ingrat, perfide, voleur,* Gall was always dignified and calm, and on these occasions usually said to her, "*laissons cela.*" He considered himself basely treated, but trusted to posterity for justice. He always contented himself with saying, if others mentioned S.'s conduct, "C'est un mauvais homme!" even on his death-bed, when, after much difficulty, he was prevailed upon to consent to see Dr. S., though his wife prevented the interview. When he mentioned, in the middle of the second volume, that he united Dr. S.'s name with his own no longer, he entered into no particulars. He afterwards yielded to the wish of his friends to take notice of Dr. S.'s publishing, like so many other of his auditors, a very incomplete account of his doctrines (un traité très-incomplet de ma doctrine), and "pretending in many places to have introduced views much more philosophical than those of the original author, who, according to the expressions of Dr. S.'s friends in the journals, had left his child in its cradle." (4to. vol. iii. p. xvi.) He then accused Dr. S. of having copied 246 pages of his quarto work into his own 8vo of 361 pages. "He will affirm," says Gall, "that he had a right to do so, because he worked with me at the first volume and the sections on innate dispositions. But he knows that his occupation was to furnish merely the literary notices. He should, at least, have mentioned the sources of his riches. He had not the same right over *my* sections on the organ of the soul and the plurality of organs. Others have already accused him of plagiarism: it is, at any rate, very ingenious to make books with scissars." Yet such was Gall's philosophy that he told me that, although Dr. S.'s conduct had been such as to determine him never to see Dr. S. again, he was far more vexed at the speculative turn which Dr. S. gave to phrenology, — more vexed that, while he himself had adhered closely to observation, Dr. S. had introduced conjecture and inference from too few observations. Gall lamented to me this turn in the Edinburgh phrenologists; and so, strange to say, did Dr. S. Having once expressed his opinion of Dr. S.'s conduct, he was too dignified ever to revert to the subject in the rest of the work, and merely refuted him here and there on points in which Dr. S. had broached new and erroneous opinions. Dr. S. in his *Essai Philosophique*, in 1820, attempted a defence, but with so much misstatement, sophistry, and rudeness, and withal weakness, that Gall, though he

and moral character, sexual, national, and individual, and cranial form and size, and in tracing the resemblance of children to their

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published his six 8vo volumes, one by one, afterwards, never condescended to notice it, satisfied that his own writings rendered any specific refutation superfluous, and always convinced that such matters right themselves with posterity. He spoke of all his own discoveries, as I mentioned in the last page, without feeling it necessary to allude to Dr. Spurzheim's absurd claims. I always felt certain that Dr. S. was an unhappy man, though I could not tell why before I studied the works of Gall and had the unspeakable happiness and advantage of knowing him personally. Every sentence in Gall's works is his own; and every thing in Dr. S.'s writings, which is also in Gall's, belongs to Gall.

I mention all this from my veneration for Dr. Gall, and my anxiety to see justice done him. Very few in this country have studied Gall. I am not acquainted with six persons whose native tongue is English, even among writers and lecturers on phrenology, who have not learned phrenology second-hand from Dr. S., or third-hand from Mr. Combe's writings, since these are in English, and comparatively short, while Gall's are in French, and of great extent. That the injustice done to Gall is such as to demand the pains I have taken, is proved by the custom among phrenological writers in the English language of speaking of the *system of Gall and Spurzheim*, of the *founders* of phrenology (for instance, *Ed. Phr. Journ.* No. iv. p. 628., No. v. p. 98. 110., No. vi. p. 186.) and the habit of such writers of quoting from Dr. S.'s works, passages which were written by Gall and are taken from his works. (Mr. Combe, *Phrenology*, p. 100., also p. 3. 5. and 44.) Nay, many of Dr. S.'s friends used always to declare that Gall had not given the philosophy of phrenology, but merely collected facts. At a public dinner given to Dr. S., Mr. Combe unintentionally disparaged Gall by declaring that Dr. Spurzheim had infused philosophy and system into the facts brought to light by observation. * Oh! shade of Gall! Had Mr. Combe studied every line of Gall's two works again and again, and hung over them at midnight as I have, and conversed with Gall as I did again and again, I am sure he is so conscientious that he would not have written thus! — that all the

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* *Edinburgh Phrenological Journal*, vol. v. He then called Dr. Spurzheim Gall's "rival in genius." In his *Phrenology* (p. 53.), he says that Dr. S. formed "the truths brought to light by their joint observations, into a beautiful and interesting system of mental philosophy." Gall's works are said, in the *Journal*, No. vi. p. 188., to be "more like a collection of *unconnected* facts;" while Dr. S. has given them "more the character of a science" "by a *more* systematic and philosophic arrangement." Mr. Carmichael's feelings towards his friend Dr. Spurzheim do him credit, but have rendered him, like Dr. S.'s other friend,—Mr. Chenevix, guilty of great misstatement and great injustice towards Gall, in his *Memoir of the Life and Philosophy of Spurzheim*. Dublin, 1833. See p. 4. sqq. 9. sq. 51. He says that Gall examined the brain "according to the old school and with mere mechanical views" till Dr. S. joined him!!

parents in the latter respect, as well as in talent and disposition; and he will not merely find incessant amusement, but feel himself

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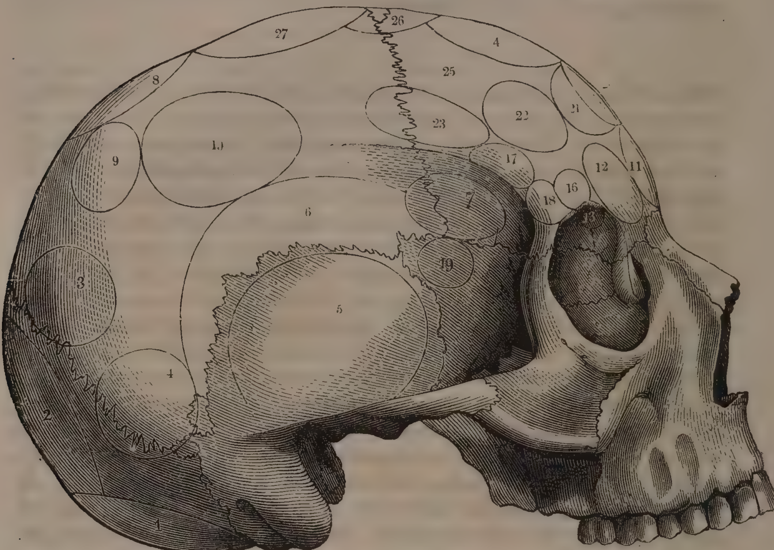
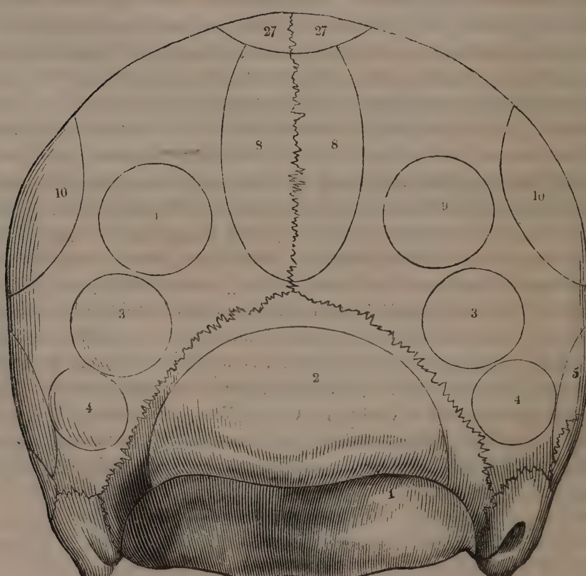
philosophy was Dr. Spurzheim's! In one part (*Phrenology*, p. 666.) he says that Dr. Spurzheim "is second in fortune rather than in merit to Dr. Gall!" "that we owe much of its excellence and interest to this gifted individual; he has enriched it with the most valuable anatomical discoveries; ascertained the functions of several highly important organs; shed over it the lights of a refined and analytic philosophy, and pointed out the most important field of its application:" "with profound gratitude and respect, therefore, I acknowledge myself indebted," not to Gall, but "to Dr. Spurzheim, for the greatest gift which it was possible for one individual to confer on another, — a knowledge of the true philosophy of man." In the *Ed. Phr. Journ.* No. vi. p. 186., the editors "are almost inclined to doubt whether they are right in assigning Dr. S. a place second to any." (l. c. p. 666.) M. Chenevix, in the *Foreign Quarterly* (p. 9.), among other incorrect statements, says that the old method of dissecting the brain appearing faulty, "Drs. Gall and Spurzheim were induced to invent some other mode." In America, where phrenology has been hitherto learned solely from Dr. S.'s book, and from himself personally, they are still more extravagant. "The labours of Dr. Spurzheim as an anatomist have produced a reform in the study of the nervous system which will for ever sustain him in the first rank of his profession. To be convinced of this, we have only to examine the state of knowledge in relation to the anatomy, physiology, and pathology of the brain and spinal marrow, before he devoted himself to the investigation of those most important branches of science." (Gall had therefore done nothing!) "That Spurzheim was superior to Gall as an anatomist, we believe all admit!" They then quote an assertion of Dr. S., that Gall once said to him, in 1805, "let us prosecute *our original plan* honestly; you, Spurzheim, as an anatomist, and I as a physiologist." If there was any truth in this, it could only have amounted to some kind encouragement of Gall to the young man; for Gall had then made all his important discoveries, and Dr. S. had only just finished his studies, just begun to learn to dissect the brain, and been engaged by Gall as his assistant. Hear the same writer again. "To express a preference is not to decide the question; and when we evince our partiality for Spurzheim as a philosopher, we merely give an individual opinion. His views, in our estimation, are more philosophic than those of Gall; more consistent, and more practical. Spurzheim carefully studied all the parts of the science with reference to each other, and aimed at a perfect whole. Gall did not do so much." (*Phr. in connection with the Study of Physiognomy, to which is prefixed a Biography of the Author*, by Nahum Capen. 1833. Nay, Dr. S.'s English friends at one time treated Gall's name with contempt, to elevate Dr. S. When Dr. S. lectured here, I heard his friends declare that his doctrines were worth their weight in gold — that *he* was the philosopher: whereas when I went to Paris, and conversed with Gall, I heard from his lips all the philosophy for which Dr. S. had gained credit in England; — I immediately saw the difference between the great original and the pupil. Those who are well acquainted with Gall's writings, and knew both him and Dr. S. in

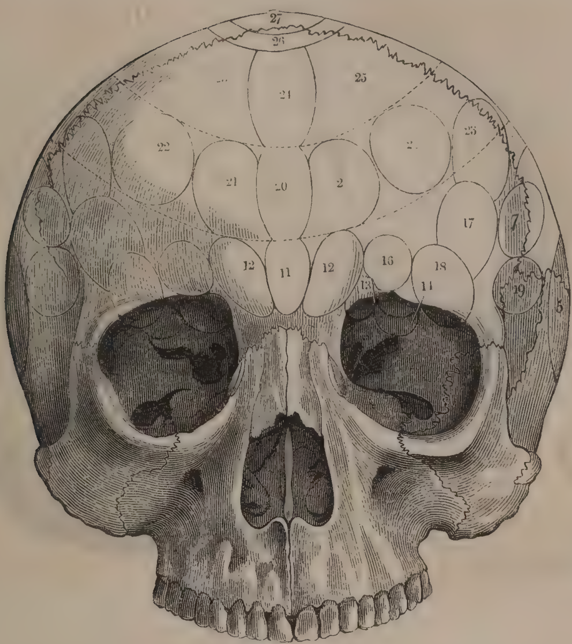
possessed of a power in his intercourse with men and books relating to the human character, to which those unacquainted with phrenology are perfect strangers.

Paris, enter into my feelings on this subject; and Dr. Fossati lately printed a letter published by Gall to a M. Retzius, in 1798, in which he laid down the plan of his work. Because Dr. Fossati complained that too many put Dr. S. on a par with, or even above, Gall, the *Edin. Phren. Journ.* No. xlvi. p. 506. reproved Dr. Fossati for this "twaddle." But Dr. Fossati spoke the truth. Gall is, indeed, called the original; but, in the next breath, we hear of the *founders*, or the *system of Gall and Spurzheim*. See *Ed. Phr. Journ.* as quoted in the last page, and various other writings. Yet, although the *Ed. Phr. Journ.* calls Dr. S. the founder of phrenology with Gall, Dr. S. does not venture such a dangerous length, but on all occasions acknowledges, what all Europe knows, — that Gall is the sole founder. He only reduces Gall's discoveries as low as possible. It tells very much against Dr. S., that all those who were intimate with him have been more or less unjust towards Gall, and some have spoken contemptuously of Gall, in regard to both his intellect and moral feelings, contrasting him with Dr. S. One London phrenologist declared that Gall's forehead was only for collecting facts, while Dr. S.'s was for philosophy. A great Edinburgh phrenologist referred me to the inferiority of Gall's organ of conscientiousness. Now, in truth, Dr. S.'s forehead is far less full and square than Gall's, and his whole coronal surface together, indicating the high moral feelings, equally inferior to that of Gall. The intellectual and high moral part of Gall's head are magnificent, and those of Dr. S. will bear no comparison with them. His firmness, self-esteem, and courage also are so large that we see at once how he was enabled to rear phrenology, and present it steadily to the world for so many years, standing alone and braving the contempt and attacks of the learned and unlearned. It is greatly to be lamented that Gall's 8vo work is not translated; and I am certain that the legacy left by a Scotch gentleman to aid phrenology could not have been laid out to half the advantage in any other way than in publishing a cheap translation of it. Pure as were the motives of the gentlemen intrusted to fulfil the wishes of the spirited bequeather, in publishing works of their own, I am convinced that they would have done far better in publishing the writings of the founder before any thing else, — writings so eloquent and convincing, and so divested of speculation, so overwhelming in proofs, that their translation would have formed the surest foundations for a universal conviction of the truth of phrenology. The injustice I complain of in phrenologists arises, I am certain, solely from their not having studied Gall as they have Dr. S., and from many not having read a syllable of Gall. When my reading was confined to Dr. S.'s books, and I was acquainted with him only, I committed the very same injustice to Gall which I now most earnestly and respectfully entreat phrenologists to commit no longer.

I shall here present some views of the organs according to Gall. The references will be found *suprà*, page 349. sq.

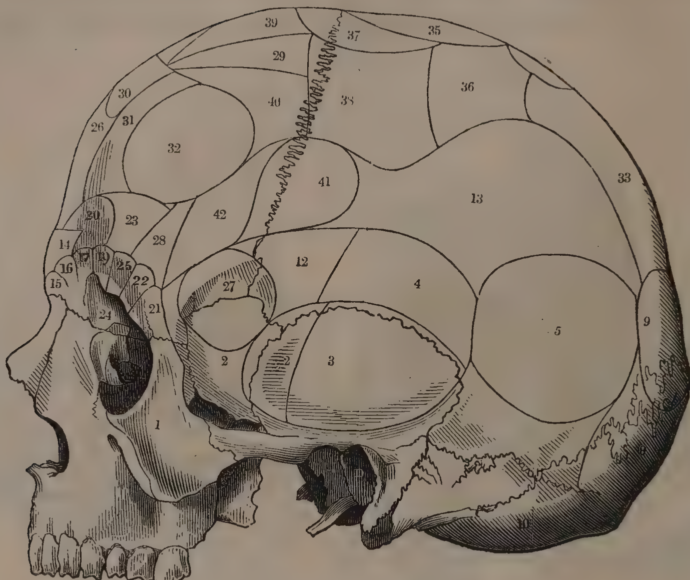






The following are from Dr. Vimont, and show all the organs admitted by both Dr. Spurzheim and himself.

1. Conservation.
2. Alimentation.
3. Destruction.
4. Cunning.
5. Courage.
6. Choice of places.
7. Concentration.
8. Attachment for life, or marriage.
9. Attachment.
10. Reproduction.
11. Attachment to the produce of conception.
12. Property.
13. Circumspection.
14. Perception of substance or objects.
15. Configuration.
16. Size.
17. Distance.
18. Geometrical sense.
19. Resistance.
20. Localities.
21. Numbers.
22. Order.
23. Time.
24. Language.
25. Colouring.
26. Eventuality.
27. Talent of construction.
28. Musical talent.
29. Talent of imitation.
30. Comparison.
31. Causality.
32. Discrimination.
33. Vanity.
34. Self-esteem.
35. Firmness, perseverance.
36. Conscience.
37. Veneration.
38. Hope.
39. Benevolence.
40. Sentiment of the marvellous.
41. Poetical sentiment.
42. Sentiment of the beautiful in arts.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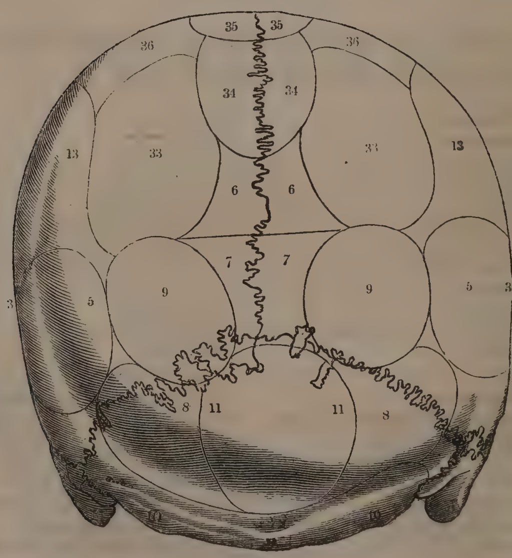
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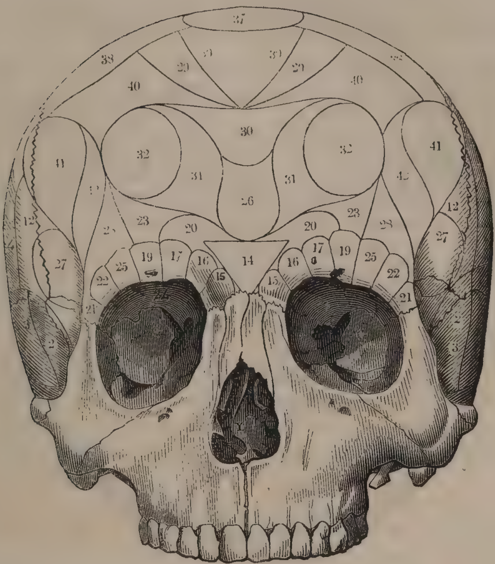
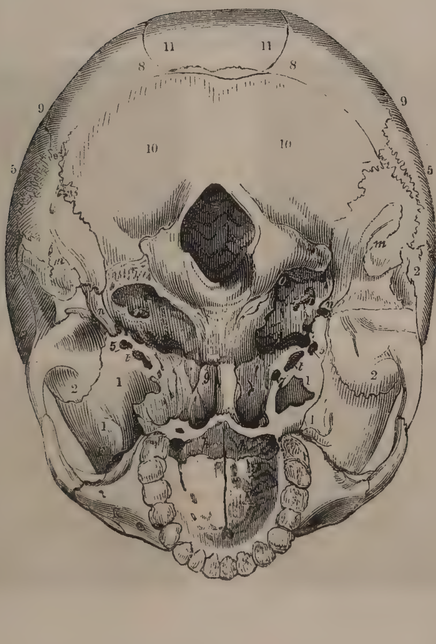
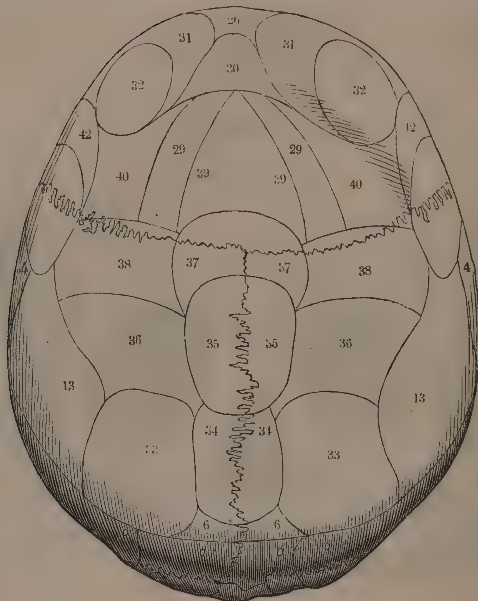
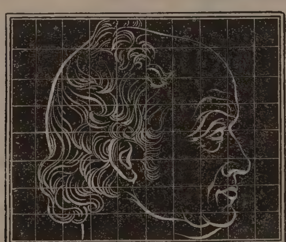
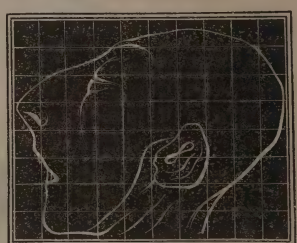




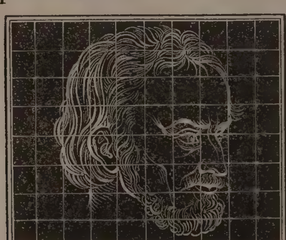


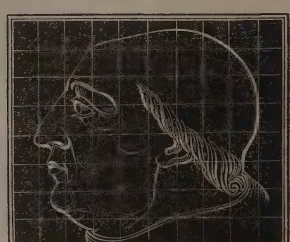
As an intellectual contrast, I present the head of Gall and of a Dutch adult idiot, whose skull is delineated by him, and is in the National Museum at Amsterdam, where I have seen it.





As a moral contrast, I present the head of Melancthon and of Pope Alexander VI.





Should any one doubt his acquaintance with the real talents and character of those friends whose heads he can select for ob-

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I must here subjoin some remarks from Gall on the reception which has been given to phrenology.

"The followers of the different schools of philosophy among the Greeks, accused each other of impiety and perjury. The people, in their turn, detested the philosophers, and accused those who investigated principles, with presumptuously encroaching upon the rights of the deity. The novelty of the opinions of Pythagoras caused his banishment from Athens; those of Anaxagoras threw him into prison; the Abderites treated Democritus as a madman, because he dissected dead bodies to discover the cause of insanity; and Socrates, for demonstrating the unity of God, was condemned to drink hemlock.

"The same scandal had been renewed at all times and in all nations. Many of those who distinguished themselves in the fourteenth century by their knowledge of natural things, were put to death as magicians. Galileo, for proving the earth's motion, was imprisoned at the age of seventy. Those who first maintained the influence of climate upon the intellectual character of nations were suspected of materialism.

"Universally, nature treats new truths and their discoverers, in a singular, but uniform manner. With what indignation and animosity have not the greatest benefits been rejected? For instance, potatoes, Peruvian bark, vaccination, &c. As soon as Varolius made his anatomical discoveries, he was decried by Sylvius as the most infamous and ignorant madman. *Vesanum, litterarum imperitissimum, arrogantissimum, calumniatorem maledicentissimum, rerum omnium ignarissimum, transfugam, impium, ingratum, monstrum ignorantiæ, impietatis exemplar perniciosissimum, quod pestilentiali halitu Europam venenat,* &c. Varolius was reproached with dazzling his auditor by a seductive eloquence, and artificially effecting the prolongation of the optic nerves as far as the thalami. Harvey, for maintaining the circulation of the blood, was treated as a visionary; and depravity went so far as to attempt his ruin with James and Charles the First. When it was no longer possible to shorten the optic nerve, or arrest the course of the blood in its vessels, the honour of these discoveries was all at once given to Hippocrates. The physical truths announced by Linnæus, Buffon, the pious philosopher Bonnet, by George Le Roy, were represented as impieties likely to ruin religion and morality. Even the virtuous and generous Lavater was treated as a fatalist and materialist. Every where do fatalism and materialism, placed before the sanctuary of truth, make the world retire. Every where do those, upon whose judgment the public relies, not merely ascribe to the author of a discovery the absurdities of their own prejudices, but even renounce established truths if contrary to their purposes, and revive ancient errors, if calculated to ruin the man who is in their way.

"This is a faithful picture of what has happened to me. I have, therefore, some reason to be proud of having experienced the same lot as men to whom the world is indebted for so great a mass of knowledge. It seems that nature has subjected all truths to persecution, in order to establish them the more firmly; for he who can snatch one from her, always presents a front of brass to the darts hurled

servation, he has only to study the heads of some celebrated men now living, or the authentic casts of the departed, of whose talents

against him, and has always force enough to defend and establish it. History shows us that all the efforts and sophisms which are directed against a truth once drawn from darkness, fall like dust blown by the winds against a rock.

"The instance of Aristotle and Descartes should be particularly quoted, when we wish to display the influence of prejudice upon the good or bad fortune of new doctrines. The opponents of Aristotle burnt his books; afterwards, the books of Ramus, who had written against Aristotle, were burnt, and the opponents of the philosopher of Stagira declared heretics; and it was even forbidden by law to dispute his doctrines, under pain of being sent to the galleys. Now there is no longer any discussion about the philosophy of Aristotle. Descartes was persecuted because he taught the innateness of ideas, and the University of Paris burnt his books. He had written the most sublime thoughts upon the existence of God; Voët, his enemy, accused him of atheism. Afterwards, this same university declares itself in favour of innate ideas; and when Locke and Condillac attacked innate ideas, the cry of materialism and fatalism resounded on all sides.

"Thus, the same opinions have at one time been regarded as dangerous because they were new, and at another as useful because they were ancient. We must, therefore, pity mankind, and conclude that the opinions of contemporaries as to the truth or error, and dangerous or innocent tendencies, of a doctrine, are very suspicious, and that the author of a discovery should be anxious only to ascertain whether he has really discovered a truth or not. A truth once discovered, will make its way, and not fail to produce good effects. 'Reason,' says Ancillon, after Bonnet, 'knows no useless nor dangerous truths. What is, is.' This is indisputable, and is the only answer to be made to those who, putting all things in subordination to men's wants, ask, What is the use of that? and to those who, always yielding to fear, ask, What may that lead to? Jesus, the son of Sirach, had already said, 'we ought not to ask what is the use of that: for the use will have its reward in time.'" *

When delivering the Lumleyan lectures, and asserting the importance of percussion and auscultation, for the first time, before the College of Physicians, in 1829, I reminded the College, "that the greatest discoveries had generally been at first ridiculed, and their authors, no less than all the truest benefactors of the human race, despised and rejected of men.

—— 'Romulus, et Liber Pater, et cum Castore Pollux;
Dum terras hominumque colunt genus, aspera bella
Componunt, agros assignant, oppida condunt,
Ploravêre suis non respondere favorem,
Speratum meritis.'" Hor. *Ep.* 1. lib. ii.

* l. c. 8vo. t. i. p. 221. sqq., 4to. t. iv. p. 75. sqq., where alone the sentence "a truth once discovered," is found; but where the third and fourth paragraphs are not.

or disposition no one can have the slightest doubt, and he will find the coincidence, within the limitations which I mentioned, astonishing and invariable.

I then mentioned the fate of Harvey (v. *suprà*, p. 194. sq.)*, and the original rejection of the discovery of the lacteals (v. *suprà*, p. 140. sqq.), and continued: —

"Let us remember that Sydenham, whose memory *we* also honour, was, by many of his contemporaries, whose names, whatever bustle they made during their existence, have never once been mentioned since their death, *called* a quack and a murderer.†

"Let us remember, that, if the illustrious father of modern philosophy was not vilified and imprisoned, like Galileo, for announcing truth, he was represented by Cecil to Elizabeth, when she thought of making him her solicitor-general, 'as a man of mere speculation, — as one wholly given up to philosophical inquiries, *new indeed and amusing*, but *fanciful and unsound*, and therefore more likely to distract her affairs, than to serve her carefully and with proper judgment.'

"In ancient times, Horace saw his odes despised because they were *new*. The public, he said,

—— 'Nisi quæ terris semota, suisque
Temporibus defuncta videt, fastidit et odit;
Est vetus atque probus centum qui perficit annos.'

But, like the illustrious Gall, Laennec is no more.

'Extinctus amabitur idem.'

"In the words of Professor Playfair, notwithstanding the splendour of Newton's discoveries; the beauty, the simplicity, the grandeur of the system they unfolded, and the demonstrative evidence by which that system was supported;" "the Cartesian system of vortices kept its ground for *more than thirty years* after the publication of these discoveries," "and actually the Newtonian philosophy first entered the University of *Cambridge* under the protection of the Cartesian," by a stratagem of Dr. Samuel Clark, who quietly explained the views of Newton, without any appearance of argument or controversy, in the form of notes to a new translation which he published of the French Cartesian work, long established as the text-book by the tutors of the University.

"Dr. Chalmers, speaking of the first reception of the Newtonian philosophy, says, 'Authority scowled upon it, and taste was disgusted by it, and fashion was

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* I might have added the words of the *Edinburgh Review*, No. xciv.: "The discoverer of the circulation of the blood suffers no diminution of his reputation in *our* day, from the *incredulity* with which *his doctrine* was received by some, the *effrontery* with which it was *claimed* by others, or the knavery with which it was ascribed to former physiologists."

† Here I might have added that, though Sydenham resided in Pall Mall, he was never employed by the Court; yet the names of the Court physicians of his day are now no more known than the names of the Court footmen.

If these are facts, all objections on the score of fatalism and materialism are unworthy of attention. Because no rational

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ashamed of it.'" (My Lumleyan *Lectures on the Diseases of the Heart,* referred to *suprà,* p. 174.)

Father Pardies wrote against the experiments and what he was pleased to call the *hypotheses* of Newton,—the very words of uninformed antiphrenologists. Such great astronomers and mathematicians as Cassini and Maraldi were calculating the paths of comets on the most imaginary and unfounded hypotheses, long after Halley had constructed tables on the principles of Newton, in which the motions of all comets that ever had appeared or could appear might be easily deduced; and Voltaire remarks that, though Newton lived nearly forty years after the publication of his *Principia,* he had not twenty followers out of England at the time of his death. Some great philosophers died in perfect ignorance of them.

The introduction of Greek was originally opposed with violence at Oxford, though now it is taught there as one of the most important things that a well educated man can know.

The music of Gall's countryman, Handel, though it has enraptured the English for a century, is now only beginning to be appreciated in Germany.

Even I have lived long enough to see things at once rejected with scorn, which are now all but universally adopted. When Laennec first published his great work, I procured a stethoscope and investigated his statements. Although the facts of percussion, as detailed by Avenbrugger above half a century ago, must of physical necessity exist, I had always been taught, by the first teacher of medicine in London, at Guy's Hospital, Dr. James Curry, that they were fallacies, and they were dismissed in three minutes as unworthy of the slightest attention. Education, therefore, tended to make me sceptical. But I soon found that Avenbrugger had been disgracefully neglected in this country; and that Laennec, like Avenbrugger, had opened to us a new and extensive scene in disease, to which, though it had always existed, we were blind — that we had eyes and saw not — or really, to drop metaphor, that we had ears and heard not. For a length of time I found some at St. Thomas's treat percussion and auscultation with ridicule; some with absolute indignation; and others, for years, treated it with silent contempt; who all, I am happy to say, now practise both. I was therefore in the habit of studying them in the wards alone, and at hours when I expected to be unobserved. When I at length advocated and taught them in the school, one of my colleagues, I heard, pronounced it nonsense or worse in his lecture; and at the College of Physicians I heard a senior fellow, in a Croonian lecture, denounce the folly of carrying a piece of wood (some called the stethoscope *inutile lignum*) into sick chambers and making observations, to the destruction of all philosophical and dignified views, such as become men whose minds have been enlarged by the education which Oxford and Cambridge afford. When another fellow of the College was asked his opinion of auscultation in the wards of his hospital, he at once, as I was informed by the gentleman who asked the question, condemned it as nonsense; and when told "that Elliotson assured his friends that he had a high opinion of it and made his diagnosis of affections of the chest with infinitely more accuracy by its means," he replied, —

or religious person believes that one truth can contradict another; or that a truth can lead to any thing but good. But,

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"Oh! it's just the thing for Elliotson to rave about!" Yet good sense and truth have prevailed. This physician is now addressed as one who had the candour to examine auscultation at an early period, when others despised it, and who materially assisted to spread its adoption. Even Dr. Spurzheim was as unphilosophical on this point, as others were in regard to phrenology. On seeing a stethoscope one day upon my table, he said — "Ah! do you use that hocus pocus?" And on my replying that it was highly important to employ the ear, he added, "You learn nothing by it; and if you do, you cannot treat diseases the better." Both which remarks were incorrect, and showed an unhappy state of mind. An old physician, on seeing me use the stethoscope, began our consultation by informing the practitioner, whom he had never seen before, and myself, that he "never made use of these French fooleries." Yet ignorance of percussion and auscultation is now considered a sufficient proof that a man knows but half his profession, and Laennec's name has become imperishable; and I am happy in looking back upon the assistance I rendered to the establishment of auscultation and percussion in this country by making the numerous physicians' pupils of St. Thomas's Hospital ear-witnesses of facts which others in vain attempted to bring into contempt.

For years after I published my work on Prussic Acid, in 1820, referred to *suprà*, p. 223., very few persons would employ it; and I was not only ill spoken of for recommending what was useless, but till very lately condemned for using dangerous poisons. Not three years ago, a practitioner whom I had never seen or even heard of, urged this in an argument with a nobleman to prevent me from being consulted in the case of his lady. While the last edition of the Pharmacopœia was preparing, in 1824, the committee drew up a Latin formula for its preparation: but when they presented their sketch of the new list to the College, they begged to withdraw the formula for prussic acid, because they had received so many letters from fellows against its utility and safety. It was consequently not admitted; and it was said in a medical journal, ten years ago, to be no longer employed by the profession. Yet it is now employed universally and daily by good practitioners of all ranks, for some pectoral complaints, for which it had been recommended on the Continent, but chiefly for stomach affections, in which I had discovered its great utility; and all my statements of its properties are established. And, although for my knowledge of its properties in regard to the stomach I was indebted to no one, I was compelled to show a second time how accident first made me acquainted with its power over the stomach, and how I was led on step by step to investigate and discover its great virtues in affections of this organ. (See the *Lancet*, Feb. 24. 1827, p. 671. sqq.)

Three months after I had first published (in the *Transactions of the Med. and Chir. Society*, for 1823, vol. xii.) a full report upon Quinine (the first that appeared in this country), I heard, at a meeting of the College of Physicians, an hospital fellow on one side of me, ask another hospital fellow, who is now in high practice, what he thought of this Quinine. The reply across me was, "Nothing; the very

in reality, phrenology gives no *additional* support to such views. It leaves all questions of fatalism and materialism where it found

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name of it will not be known in a twelvemonth!" Yet Quinine is now as much used as rhubarb, though neither it nor Prussic Acid is in the Pharmacopœia; and all my statements are established.

In 1824, I published my discovery of the almost specific power of carbonate of iron in cases of general chorea before the adult period; and for pointing out (l. c. vol. xiii. 1827.) that Carbonate of Iron, when it failed in ordinary doses, might be given without the least unpleasant effect in doses ten times larger, I was considered little less than a fool, and acquired a permanent reputation for giving all medicines under all circumstances in enormous doses; though I am one of the most cautious practitioners, and always begin, in chronic cases, with small doses of medicine, increasing them by slow degrees according to the necessity; and never, from my earliest days of practice or teaching, have wished to give one grain or one drop more than proves requisite. At the same time, I certainly do not regard quantity as I proceed, but steadily augment my doses till the complaint begins to yield, or some effect of the medicine begins to appear. No practice is more irrational than to discontinue a medicine simply because it does nothing, or before you have step by step augmented the dose till some circumstance manifests that the medicine is not inactive. Difference of quantity and difference of continuance must be demanded in different cases. I did not feel myself justified in recommending large doses of iron as more efficient than small. But farther experience proved to me the superior power of large doses of carbonate of iron in obstinate cases; and in 1827 (l. c. vol. xiii.), I stated this, and have proved it to the crowds of students at the North London Hospital again and again. The possibility of giving the large doses of the medicine ordinarily is now no longer doubted. I next announced the power of large quantities of Carbonate of Iron over Tetanus (l. c. vol. xv. 1829.), and this has been confirmed. (*Lond. Med. Gazette*, Sept. 14. 1833.) A gentleman from the West Indies told me he had great success with it. But no one else gives it a trial, and old means which have failed again and again are absurdly repeated.

When I displayed the utility of sulphate of copper in chronic diarrhœa, in 1827 (l. c. vol. xiii.), some contended that the opium combined with it effected all the good, although I had so proceeded as to prove how much was owing to the salt. I now possess heaps of letters expressing the realisation of my statements from practitioners of various parts.

In 1830, I proved the occurrence of glanders in the human subject, notwithstanding its possibility was denied. (l. c. vol. xvi.) I was smiled at for my credulity. Yet extracts from my papers and copies of my engravings have now a place in Dr. Rayer's work upon the Diseases of the Skin, to which no other is comparable; and, in noticing some foreign cases just published, the editors of the *Brit. and For. Med. Review*, for July, say the occurrence is no longer a novelty. (p. 241.) After my first paper appeared, the lecturer on veterinary medicine in the University of London, to whom I had given a copy, did not condescend to notice it; and, making a passing observation upon the belief of the occurrence of the disease in the human subject,

them. Every thing in nature is subjected to laws which must be obeyed. The nature of every thing is destined. A stone is des-

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was perfectly silent in regard to my facts, and considered such an opinion as the result of inaccurate observation, referring to some one else, not to me. (*Lancet*, No. 436.) After my second paper was published, (l. c. vol. xviii. 1833.) in which I gave another case, he could no longer profess a doubt; but, in admitting the fact, now said that it had "long been suspected, or rather painfully known." (*Veterinarian*, March, 1833.)

For having discovered the extraordinary power of Creosote in arresting vomiting, unconnected with inflammatory or structural disease of the stomach, in an immense majority of cases (l. c. vol. xix. 1835.), I am now going through a course of sneers and attacks. Some who cannot have, and others who evidently have not, employed it according to my directions, nor to one twentieth of the extent, assert that they have not found it so useful as I have, and put it on a par with medicines as inferior to it as lettuce to morphine: and the reviewers, who are lauded as respectable above all others, untruly say that I call it never failing; whereas I pointed out two forms of vomiting in which it is useless and even injurious, and mention that where it seems proper it occasionally fails, and that it so disgusts some persons that the stomach will not bear it; and, though, after a laborious and rigid examination of its effects for a twelvemonth in a large practice, I have pointed out various diseases and forms of disease in which it is useful, I really have pronounced against it in a still greater number of diseases and opposed writers who eulogised it absurdly. I shall always congratulate myself upon my good fortune in discovering the extraordinary power of creosote over nausea and vomiting and to enable the stomach to bear medicines which disagree with it; and all I stated in regard to it is confirmed by still farther hourly experience up to this very day, and will stand firmly, notwithstanding the assertion of Drs. Forbes and Conolly, who untruly make me have "unlimited confidence" in creosote and call it "never failing," and who assert that "in other and equally judicious hands it has fallen very far short of the virtues ascribed to it" by me, "and that it more frequently fails" in cases in which I say I have found it successful. To crown all, they make a lecturer, who confirms a candid remark of mine, be confirmed by me. (July, p. 170. 200.) The testimony of hundreds of my pupils and patients is happily against them.*

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* Except the narrative of a case of rupture of the stomach (l. c. vol. xiii.), and one of rupture of a pregnant Fallopian tube (l. c. vol. xiii.), my only other paper in the *Transactions* is on Fatty Discharges from the Alimentary Canal and Urinary Passage (vol. xvii. 1833.). In it I collected a great many instances, and deduced several general facts as to the disease. 1. That the fat might be discharged solid or liquid, or both. 2. That the disease might be temporary, or permanent, or even fatal. 3. That there might be organic, or merely functional disease. 4. That the organic disease might be in the intestines, liver, or pancreas. 5. That fatty discharge might take place from the alimentary and urinary organs at the same time. Yet this paper was called a mere collection of cases.

tined not to feel; a fish is destined to swim, and a vulture to be a bird of prey; man is destined to be —

What I experienced during many years for my humble and conscientious efforts to propagate the advancement of whatever, by zealous and dispassionate observation I knew, within my own experience, to be true and useful, distressed me greatly, till I rose in spite of it in my profession. I am aware of the injuries I still suffer from the bad feeling of those who are not so devoted to the profession as myself and yet envy me. But I now smile at it, and forgive all; and shall firmly persevere, never withholding my aid to useful truths nor shrinking from conduct which I consider my duty.—From this narration I trust that young men will never be deterred from an industrious and conscientious course, but be prepared to expect all that I have experienced, and remember the advice of the Sibyl to Eneas, "Tu ne cede malis, sed contra audentior ito." We thus find the fate of the little to be the same as of the great, if they humbly take these for their guide.

But the most notorious modern illustration of the aversion to improvement is the history of lighting with gas. When I was a student, I recollect often going from the Borough Hospitals in the evening to see Pall Mall, which only, of all the streets of London, was so lighted. For many years a person named Winser, and a company which he established, lighted that single street, I believe gratuitously. This was a bright spot in London, for comparative darkness prevailed in every other street. For many years, the general adoption of the plan was considered impracticable and therefore absurd. At length, another street was lighted — and another — and another — and now that the poor man is dead, all London is become Pall Mall, with one exception. Year after year have I amused myself with watching the progress of illumination, and comparing it with the history of the progress of great truths in physical, moral, and political science. Yet not even is it at this moment universally adopted, any more than many obvious truths. Darkness is still cherished in that very spot of London, where the greatest riches and the highest rank, both transmitted hereditarily in the longest succession, ought to have secured, with Oxford and Cambridge education and every advantage of mental cultivation, from generation to generation, the highest knowledge and discernment. No house in Grosvenor Square has any other than the greasy, dull oil lamps, notwithstanding all the streets opening into it and even the centre of the square which the parish lights, are brilliantly illuminated with gas. I have taken foreigners into Grosvenor Square to exhibit this *moral* phenomenon.

These are all remarkable facts in the history of human nature; and make me quite indifferent to the opinions of people, whether in my own profession or not, upon the subject of phrenology. Yet its progress has of late been most satisfactory. When I wrote advocating phrenology, in 1817 *, the year of my

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* *Annals of Medicine and Surgery*, vol. ii. March 1817. I believe I was the first reviewer who defended phrenology in Great Britain. I subsequently wrote a review of the *Ed. Phr. Trans.* and of the first Number of the *Ed. Phr. Journ.*

——— "Not prone
And brute as other creatures, but endued
With sanctity of reason, and to erect
His stature, and upright, with front serene,
Govern the rest, self-knowing." [u]

The very expression "human nature" implies certain innate faculties and dispositions, *generally;* the circumstance of *peculiar*

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appointment to St. Thomas's Hospital, I did not know six phrenologists in England; and, when I founded the Phrenological Society of London there was none in England or abroad. They now exist in many parts of Scotland, where the first Phrenological Society was established; in many parts of England, in Ireland, America, Denmark, and Paris, where, however, no one existed till Gall's career was finished, — 24 societies in all. In Paris the most distinguished in our profession are phrenologists. To the everlasting honour of Edinburgh, not only was the first Phrenological Society established there, but the first Phrenological Journal; and a treatise on the science by Mr. Combe has passed through three editions, and made its hundreds of converts: 14,000 copies of his phrenological works have been sold. (*Statistics of Phrenology*, by H. C. Watson. London, 1836.) On the stand made by Mr. Combe and his circle in Edinburgh, the seat of a hostile celebrated Review, of a University, and of great religious bigotry, too much praise on the score of intellect and moral principle cannot be bestowed. Thousands of well-informed persons in this country are now phrenologists, — a very large number in my own profession. Though the Pope put Gall's works into the Index Expurgatorius, phrenological treatises have lately been permitted in the states of his Holiness, as well as by Austria in Milan and Pavia. Phrenological language is of daily use with our best writers and teachers; though they too often fear to declare their conviction. I have never known an individual write or speak against phrenology,

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in Dr. Johnson's *Med. Chr. Review;* and have read in the London Phrenological Society a paper on Imitation, reported in the *Lancet*, 1827, No. 190. — on an Idiot, l. c. 1826, No. 169.—on the Head of the Incendiary Smithers, l. c. 1832, No. 486.—ditto Thurtel, — ditto Pallet, *Ed. Phr. Journ.* vol. i.— an Answer to Mr. Jerdan and Dr. Ryan, *Lancet*, No. 430.—to Dr. Kidd, l. c. 1834, No. 547. — to the Rev. Mr. Taylor, l. c. 1834, No. 548. — to Mr. Godwin, l. c. 1834, No. 432. — ditto to Dr. Pritchard, ditto to Dr. Burrows, but not reported, — ditto to Dr. Bostock, — ditto to Dr. Magendie, *Ed. Phr. Journ.* vol. v. In the *Lancet* for 1829, No. 304. and 1831, No. 400. will be found reported some curious pathological illustrations of Phrenology from my patients in St. Thomas's Hospital. In the *Ed. Phr. Journ.* vol. iv. also will be found a phrenological experiment, and in the *Lancet*, No. 642. another, both communicated by me previously to the London Phrenological Society.

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[u] *Parad. Lost*, vii.

degrees of disposition and talents being hereditary, and of each age having its distinctive character, are quite as favourable as

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without betraying a total misconception of it, or an ignorance of the facts of which the spoke. Some opposers are both ignorant and malicious.

Let us all, therefore, follow Gall's advice; and when, by careful investigation, we have satisfied ourselves of a truth, let us not be angry, but let us, remembering the words of Locke, — that few people have any solid reasons for the "doctrines they keep such a stir about" (*Hum. Underst.* iv. 21.), pity mankind and totally disregard the opinions of those who have not bestowed the same attention as ourselves or yield to malevolent passions, be they little, like the swarm, or men of real distinction.

Till Gall established himself in Paris and rose into a very fine and high practice (he was physician to many ambassadors), he kept himself very poor from spending upon his phrenological pursuits all he gained, after absolutely necessary expenses. And although he lived then in the most private manner, with the comforts indeed of a handsome lodging, a carriage, and a garden with a small house in the suburbs, he had saved so little, that, had his illness been protracted, his friends in a few months must have supported him. In his combination of intellect and moral sentiments, I doubt if any other human being surpassed him; and the frontal and sincipital regions of his head were magnificent. His cerebellum was very large, and he was twice married; and although, after separating from his first wife he had a mistress, I believe he was a model of fidelity, and married again immediately that his first wife died. His noble independence of mind cannot be better shown than in his account of self-esteem in which he evidently pourtrays himself, — a passage which I have ever in my thoughts. "There is a certain number of men endowed with such strength of mind and nobleness of soul, thoroughly sensible of their own worth, and so passionately fond of independence, that they resist every external influence calculated to subject them. They endeavour, as much as possible, to establish themselves in countries where there is the most liberty; they follow a pursuit which renders them independent, which exempts them from the favours and the caprices of the great. Dominion over their inferiors, which would lead on to slavery under an absolute master, to them would be insupportable. Honours and distinctions intended for merit, when lavished on men of no pretensions, are in their eyes only degradations. If they prosper, it is through their own exertions. Like the oak, they sustain themselves; and, for whatever they are, they consent to be indebted to no one. This is a pride which has not degenerated into haughtiness; which is often the companion of great virtues, is the enemy of all baseness, and the support of courage in adversity." (l. c. 4to. vol. iii. p. 299., 8vo. t. iv. p. 254.) "I am the most modest, the most humble of men, when I behold around me the immensity of things which I am condemned not to understand, and which, nevertheless, are connected with the objects of a medical observer and practitioner. But when the discovery of the structure and functions of the brain is spoken of, I believe myself, with imperturbable confidence, to be above all my predecessors, above all my cotemporaries. Yes; I am the first who has established the physiological principles on which the structure and

phrenology to the belief of *fatalism*. But each has his own precise talents and disposition by nature; on some circumstances or other

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functions of the brain must be studied; I am the first who has broken down the barrier opposed by superstition and ignorance, for thousands of years, to the progress of the physiology of the nervous system; the first who conceived the idea of distinguishing the general attributes from the true qualities and fundamental faculties; the first who determined the instincts, the inclinations, the sentiments, and the talents which are connected with certain cerebral parts. I am the first who had the courage, the patience, and the perseverance to examine and fix the relations which exist between the energy of the moral qualities and of the intellectual faculties, and the various development of the parts of the brain. I am the first who has extended these researches to the whole brute kingdom, who has studied thousands of animals, as to their most striking instincts, inclinations, and faculties, and the configuration of their brain, both in individuals and species. I am the first who discovered and pointed out the means of discovering the seat of each instinct, sentiment, and intellectual faculty. I am the first who discovered these seats, and demonstrated them by numerous physiological and pathological facts, and by an infinity of researches into the comparative anatomy and physiology of all species of animals."

"Yes; once more, I am the first and the only one to whom the physiology of the brain owes its existence; I have discovered it without the assistance of any man. This the history of each of my discoveries proves. It is the same with the physiology of the brain as with its structure. To pick out what might by chance be found dispersed in authors, would have required more cleverness than to detect the mysteries of nature by observation. I began, continued, and completed all my discoveries, without any previous learning; and if, at a later period, I compiled quotations, it was rather to mark the point of my departure, than to strengthen my ideas by those of my predecessors and cotemporaries." (l. c. 8vo. t. v. p. 519. sq. 522. sq.)

In his preface to the third quarto volume, *published in* 1818, and the sixth octavo, *published in* 1825, he says, "The foundation of this doctrine being laid, it must be as immovable as the materials, — the facts, of which it is constructed. But I am far from believing the edifice complete: neither the life nor the fortune of one man would be sufficient for this vast project. *Up to this present moment I have been left to my own resources.* An immense concourse of the most favourable circumstances would be required to raise this study to the height which it is capable of attaining. There would be required a complete collection of the crania of brutes, not only of different species, but also of individuals in which qualities or faculties strongly pronounced had been observed. There would be required a complete collection of the brains of brutes, modelled in wax after nature, to multiply the means of comparison. There would be required a number of crania, or at least of casts, of men and women distinguished by some quality or faculty: finally there would be required a more extensive knowledge of natural history than we have at present, with respect to instances of industrious aptitudes, qualities, and faculties; in a word, with respect to the internal economy of the brute creation."

they must depend; and, if these are discovered, the case does but remain the same as before.[o] Yet, whatever may be our innate

Dr. Vimont of Caen has carried on the researches into the phrenology of brutes with extraordinary perseverance, and produced a most magnificent work. Attracted, in 1818, by the prize offered by the French Institute to the author of the best memoir upon the anatomy of the brain in the four classes of vertebrated animals, he began researches into the subject, without any reference to phrenology, for he had not read Gall, and had seen him spoken of in books and heard of him only as a charlatan: however, he thought it incumbent upon him to read Gall's work among others. "Hardly," says he, "had I begun to read it, when I found that I had to do with one of those extraordinary men whom dark envy endeavours to exclude from the rank to which their genius calls them, and against whom it employs the arms of the coward and the hypocrite. High cerebral capacity, profound penetration, good sense, varied information, were the qualities which struck me as distinguishing Gall. The indifference which I first felt for his writings, therefore, soon gave way to the most profound veneration." (*Introduction*, p. 14.)

In 1827, Dr. Vimont presented to the Institute a memoir containing a fragment of the researches on which he had then spent so many years, together with 2500 heads of brutes of various classes, orders, genera, and species. Among these, 1500 had belonged to brutes with whose habits he had been individually well acquainted before they died, or were killed: 400 wax representations of the brain, modelled after nature, and an atlas of more than 300 figures of the brain and cranium, executed with the strictest accuracy of dimensions, also accompanied the memoir. The work in which he now sets forth his observations has an atlas of 120 exquisite plates, containing above 600 figures. The accuracy of dimensions is said to surpass any thing before attempted in anatomy; and, if the immense mass of proofs of phrenology from the human head, and the facts pointed out by Gall, in brutes, were not sufficieht to convince the most prejudiced, the additional multitude amassed by Dr. Vimont will overwhelm them.

These are the great merits of the work: I would willingly pass over its faults; but antiphrenologists will point them out, and, therefore, it is as well at once to express my regret at the self-conceit which pervades it. The author has given what he terms English as well as French explanations of the plates, but, from not availing himself of the assistance of some one possessing a better knowledge of our language, his blunders are irresistibly ludicrous. He brings Gall's knowledge and labours as low as posible, in order to elevate his own, and commits great injustice. (Vol. i. p. 15. (Not aware that Gall had

[o] All know that sexual desires are so connected with the genital organs as generally to commence when these become mature, and be prevented by their removal during childhood; but the world does not, therefore, decline to punish ravishers and adulterers. The circumstances are precisely the same with all the cerebral organs of propensity.

propensities and powers, we know how much various circumstances influence the development of faculties and the strength

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answered Tiedemann, in l. c. 8vo. t. iv. p. 42.) 36. sq. 165. 212. 219, 220., vol. ii. p. 247.) He is unjust towards Dr. A. Combe and Mr. W. Scott, in vol. ii. p. 165. 196. sq. He stands at an immeasurable distance below Gall in intellect: and, though I believe him to have collected far more facts and contributed far more to the solidity of the science than Dr. Spurzheim, his intellectual powers have not Dr. S.'s strength. Nothing can be weaker than some of his remarks on vitativeness (vol. ii. p. 160. sqq.), concentrativeness (vol. ii. p. 212. sqq. also compared with p. 407.), and on alimentativeness (p. 173. sq.), on materialism (vol. i. p. 32. sq. compare with p. 223. and vol. ii. p. 50.), and on marvellousness (vol. ii. p. 427. sqq.). There are instances of bad taste, incorrect information, and carelessness, which vex me in so important a work. He agrees with Dr. S., in considering Gall's sense of persons as a sense of form, and yet all his facts and reasoning relate to persons. He adopts all the faculties alleged to be discovered by Dr. S. and others, and even adds three of his own — the sense of distance, of beauty in the arts, and the disposition of flocks or swarms to arrange themselves in regular figures. His remarks against Dr. S.'s views on acquisitiveness, secretiveness, cautiousness, eventuality, mirthfulness, and ideality, to use Dr. S.'s terms, are really good, and such as I have always made. He, in several instances, is just towards Gall, where others have been unjust. (See vol. ii. p. 393. 459.) And, although he rectifies Gall's localisation of most of the organs in brutes, and this with rude remarks, he once does him ample justice. (Vol. ii. p. 262.) "If Gall has not treated the phrenology of brutes as he might have done, he will always have the merit of having put his successors in the right road. This celebrated man, in developing his philosophical ideas by the aid of comparative anatomy and physiology, has left an immense distance between himself and Spurzheim, and all phrenologists who have not, like the latter, followed in his path. Time, which gives every man his proper place, while it will show us the imperfections of his works, will inevitably do justice to the extent of his views." He makes a few rectifications of the situations of organs in man; but his merit is that of having given to phrenology an immense mass of additional proofs from brutes, and observed and communicated his facts with, as it would appear, the minutest accuracy. No one can pretend to a perfect knowledge of comparative anatomy and physiology, without a knowledge of his labours, and to impress their importance upon my readers, I shall quote a long passage.

"In animals of the lower classes, to begin with fish and reptiles, the number of cerebral faculties is small; their acts generally of short duration: all have a spinal chord. In the apparatus of the senses they have, externally, a multitude of shades of form and structure calculated to facilitate their actions. The most prominent cerebral faculties are conservation, alimentation, and reproduction. If there are any perceptive faculties, they are, except in some species, very limited.

"What a difference, in this respect, between them and birds! How must

of dispositions, and we feel as if we were free agents: we seem to move our right hand or our left, and to sit still or walk, exactly as we choose; and we possess reason and conscience to guide our conduct.

Yet, notwithstanding this *feeling* of freedom, "all theory is," certainly, as Dr. Johnson said, "against the freedom of the will." [p]

The truth is, that we act necessarily according to the strongest motive; our liberty consisting, as Voltaire says in his charming article on Liberty [q], in the power of doing what our will requires of absolute necessity. Johnson, therefore, added correctly,

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we be struck with admiration on observing that, with the more energetic and complicated actions of birds, the cerebral system becomes more ample! Is it not still more surprising to see the combination and energy of the faculties perfectly coincide with the wants of the species? How can we, on the other hand, refuse to be convinced of phrenology, when it proves to us, by the inspection of many thousands of skulls, that if birds, whatever be their class, order, genus, or species, or even their peculiar habits, have a faculty in common, for example that of migration or recognising places, their skulls will always resemble one another at one point; and, as this truth applies to all the faculties discovered by observation, to deny the existence of these facts is to deny that the eye is the external apparatus of sight, the ear of hearing, the nose of smelling, &c.

"In quadrupeds and quadrumana, in which the cerebral operations, generally considered, are more numerous and present a more continued action than in birds, we find the cerebral system more developed. Some organs, which were but rudimentary in the two first classes, are very prominent; and the acts dependent upon them, being more energetic, confirm the general law of nature, — the relation between the extent and force of the acts of the nervous system with its volume or development." "Full and perfect reliance may be placed on my observations; for they are the result of a scrupulous and conscientious examination of many thousand skulls of brutes, and the dissection of their brains, subsequent to the study of their most striking manners and habits."

[p] Boswell's *Life of Johnson*, vol. iii. p. 294.

Consult Gall on *Materialism, Fatalism, and Moral Liberty*, l. c. 4to. vol. ii. from p. 79. to 132.; and on *Reason, Will, and Free Will*, vol. iv. p. 340. sqq.; and on *Free Will and Liberty*, 8vo. t. i. p. 228. sqq., and t. vi. p. 427. sqq., especially on *Illusory Liberty and Moral Liberty*. All these writers, however, were anticipated in "*A Philosophical Enquiry concerning Human Liberty*, by Anthony Collins. London." Collins again owes his views to "*A Treatise of Libertie and Necessitie, wherein all Controversie concerning Predestination, Election, Free Will, Grace, Mercy, Reprobation, &c. is fully decided and cleared*, by Thomas Hobs. London, 1654."

[q] *Dictionnaire Philosophique*.

"All experience is for it." And on another occasion said, "We know that we are free, and there is an end on't."[r]

Motives depend upon original organisation, sometimes modified by physical influence, internal or external; and upon external moral influence upon our mental organs.

The being who has the most faculties, the greatest equipoise of his faculties, and the most knowledge, has the greatest range of liberty.[s] If a person acts wickedly or absurdly from hearing necessity advocated, it is because certain motives become extinguished in him and his range contracted.[t] It results that we should educate, and give as many and as good motives as possible; and, when we punish, we should punish, not from presuming we have a right to condemn, but for the purpose of giving additional motives to good conduct, where there has clearly not been enough of them.[u] As the strength of individual inclinations and the facility of yielding to them are greatly increased by habit, in order that those of a lower class should not acquire undue force, nor

> "Upstart passions catch the government
> From reason, and to servitude reduce
> Man, till then free,"[x]

the necessity for education to consist not of mere precepts and sermons, but of good actions, is apparent. One good act may be more improving than the precept read or heard twenty times.

[r] l. c. vol. ii. p. 74.

[s] Voltaire, in the article referred to, makes *B.*, the person who is ignorant of the subject, say, "Mon chien de chasse est aussi libre que moi; il a nécessairement la volonté de courir quand il voit un lièvre, et le pouvoir de courir s'il n'a pas mal aux jambes. Je n'ai donc rien au-dessus de mon chien: vous me réduisez à l'état des bêtes.

To which his better informed friend, *A.*, replies, "Voilà les pauvres sophismes des pauvres sophistes qui vous ont instruit. Vous voilà bien malade d'étre libre comme votre chien. Ne mangez-vous pas, ne propagez-vous pas comme lui, a l'attitude près? Voudriez-vous avoir l'odorat autrement que par le nez? Pourquoi voudriez-vous avoir la liberté autrement que votre chien?

B. "Mais j'ai une âme qui raisonne beaucoup, et mon chien ne raisonne guères. Il n'a presque que des idées simples; et moi, j'ai mille idées métaphysiques.

A. Eh bien, vous êtes mille fois plus libre que lui; c'est-à-dire, vous avez mille fois plus de pouvoir de penser que lui; mais vous n'êtes pas libre autrement que lui."

[t] See Bishop Butler's remarks on the mischief of the doctrine, *Analogy*, p. 1. chap. vi.

[u] Gall, l. c. 4to. vol. ii. p. 100.; 8vo. t. i. p. 289., t. vi. p. 438.

[x] *Parad. Lost*, xii.

The objections on the ground of *materialism* are not more applicable to phrenology than to the doctrine now universally admitted, — that the brain is the organ of the mind; and they have been answered.

Those who have so little soul as always to ask what is the good of *any* discovery in *nature*, may be told that phrenology may be of much service in confirming some moral views which good sense may previously have suggested. Humility and benevolence are two leading duties. If we detect the signs of intellectual deficiency and vice in our own heads, we may learn to think humbly of ourselves; and, being put in possession of true self-knowledge, endeavour to strengthen what is too weak and repress what is too strong. If we detect the signs of great talents and virtues in the heads of others, we may love them the more as superior and highly favoured beings: whereas, if we detect the signs of great virtues and talents in our own heads, we may learn to give no praise to ourselves, but be thankful for the gift; and, if we detect the signs of vice and intellectual deficiency in others, we may learn to pity rather than to censure. Not revenge, but example, is the professed, and should be the sole, object of our legal punishments; — example to the culprit himself and others, or, if the punishment is capital, to others only; and therefore frauds, which, from being very easily committed, may become very detrimental to society, are punished more severely than those which, cæteris paribus, from being difficult of perpetration, can scarcely from their frequency become dangerous. Were moral demerit regarded, the fraud easily committed would, cæteris paribus, be punished the most lightly. A vicious man must be restrained, as a wild beast[y], for the good of others, though, for aught we know, his faults may, like the acts of the beast of prey, be chargeable rather on his nature; and, while we feel justified in confining, and the culprit is perhaps conscious how richly he deserves his fate, we may pity in our hearts and acknowledge that we ourselves have often been less excusable.

> "Teach me to love and to forgive,
> Exact my own defects to scan,
> What others are to feel, and own myself a man."[z]

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[y] A man of determined bad principle may in like manner be shunned by the most benevolent, on account of being odious and dangerous; though they wish him so well as ardently to long for his reformation, and pity his organisation, his education, and the circumstances under which he has been placed.

[z] Gray, *Ode to Adversity*.

Morality is inculcated by phrenology in the most striking manner. The faculties common to us and brutes are placed the lowest; the superior faculties above: as though the former should be subjected to the latter. We learn from phrenology what several faculties do certainly exist: and, as nothing exists but for a good purpose, each should be allowed to act. But they should be allowed to act harmoniously, — not one in opposition to another: the love of property not be allowed to oppose benevolence or justice, nor any one intellectual faculty to supersede the employment of the others. The greater the cultivation of all the intellectual faculties, the more abundant will be the motives of thought and action, — the freer the will: and the more the moral faculties situated superiorly are cultivated, and the fewer provocations are applied to the inferior, the more will the former guide the individual to his own happiness and that of others.

Phrenology, too, may be of the highest use when in criminals there is suspicion of idiotism or insanity. Idiotism often depends on deficiency of cerebral development, and many idiots have been executed for crimes when it was not exactly proved that they were idiotic enough to be unfit for punishment, but whose cranial development might have settled the point at once. Many persons also have been executed who should have been considered madmen, but were not because the fact of illusion was not made out: yet the extreme preponderance of the development of the organs of the propensities over that of the moral sentiments and intellect would have proved that they were deserving of coercion rather than punishment. Such does the skull of Bellingham, the murderer of Mr. Percival, prove him to have been.

In placing confidence in others and forming connections, phrenology may be of the greatest use. We might often be at once certain of an intellectual deficiency or a moral objection. Many heads have the development of their various parts so moderate and nearly balanced, that the character will depend chiefly upon external circumstances; and such will never become remarkable. Although fulness of development does not, like deficiency, give a certainty of the internal force, because it may not depend upon brain or upon good brain; yet, when the person is known to be of sound body and mind, and not torpid, the force within will, in an immense majority of cases, be correspondent with

the fulness without.[a] Like many other phrenologists, and, indeed, like Gall himself, I have suffered from having yielded to

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[a] Gall divides men into six distinct classes in regard to the moral and intellectual faculties: —

"In the first class, the qualities and faculties which are the most elevated and are peculiar to man are completely developed, while the organs of the animal qualities and faculties have but a feeble degree of development and activity.

"In the second class, the organs of the animal faculties and qualities have attained a high degree of activity, while the organs of the qualities and faculties peculiar to man are but little developed and but little active.

"In the third class, the qualities and faculties common to animals and those peculiar to man have considerable development and activity.

"In the fourth class only one or some of the inclinations or talents is developed in an extraordinary degree, while the rest have only a moderate development and activity, and are perhaps below mediocrity.

"In the fifth class, one or some of the organs are but little developed and remain inactive, while the others are more favourably developed and active.

"Finally, in the sixth class, the organs common to animals and those peculiar to man are almost equally moderate."

"When the superior qualities and faculties more peculiar to the human species much exceed the inferior, the man will prevail over the animal. The internal movements and all the conduct of these men are conformable to reason, justice, and morality. To judge equitably of the weaknesses of others, to generously pardon offences, to tolerate with indulgence the errors of their minds, to act with integrity, always to labour for the general good, sacrificing their own interests, always to render homage to truth with a wise intrepidity, always to be above ingratitude and persecution, always to ascend from effect to cause, and thus always to shelter themselves from prejudice and superstition, &c. &c. — this is the natural tendency of these men, these models, these benefactors of our race.

"The contrary is the case with those whose organs of the animal qualities and faculties have a very considerable development and activity, while the organs of the superior faculties have but little development and activity. In these, all is subjected to sensuality and error. The animal impulses are numerous and violent; and defeat is the more to be apprehended in proportion as the superior faculties and external aid are the weaker. If unhappily the prevailing inclinations are of the number of those the excessive activity of which destroys social order, will the philosophic judge be astonished at those men too frequently becoming the victims of their organisation?

"When the qualities and faculties common to animals and at the same time those peculiar to man are equally active, men result who are placed between the man and the brute. They are stimulated by the one and warned by the other: often humiliated by the one and often exalted by the other; great in vice and great in virtue; in many points, they are excellence and wisdom itself; in many others, they are subject to the most deplorable weaknesses and vices. The most opposite qualities frequently render them the most problematical beings: such as

social impulses and neglected to pay proper attention to the organisation. But the phrenologist, and not phrenology, was in fault.

We learn how a person may lose his memory of names, and of nothing else; and how any one or a certain number of the intellectual faculties or moral feelings may be over-excited, diminished, or otherwise damaged: just as one part supplied by one nerve or set of nerves may be palsied, convulsed, or pained; and

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Louis XI., Charles V., Philip II., James II., Catherine de' Medicis, who were superstitiously devout, and at the same time the scourge of their subjects. These are the persons who most acutely feel the struggle of the two beings within them. It is Socrates, St. Paul, St. Augustin, who, having the severest battles to fight, may pretend to the most glorious victory of virtue.

"When one or some qualities or faculties, whether animal or human, are endowed with an extraordinary energy, while the others are only moderate, the result is great geniuses, great talents in a limited career, or certain inclinations, whether bad or good, predominant over the others. These talents and inclinations constitute the character of the individual, who will have the more difficulty to withstand their impulses in proportion as the other moral and intellectual powers are less active. You have the mere musician, mechanician, and impassioned poet; but you have also the libidinous, the quarrelsome, the thievish, who even, in certain cases, are so impassioned that the excessive activity of such inclinations degenerates into real madness, and deprives the individual of the power of controlling them.

"You see on the contrary, partial apathies, imbecilities, when, by the side of other qualities and faculties sufficiently developed, one or more organs are but little developed. With such an organisation, Lessing and Tichsbein detest music, Newton and Kant dislike women.

"Lastly, in the sixth class, is found the crowd of ordinary men. But, as the organs common to animals occupy the greatest part of the brain, these men remain limited to the sphere of the animal qualities; their pleasures are those of sense, and they produce nothing remarkable in any respect.

"These six divisions are mixed in a thousand modifications, as happens with all the great divisions of nature. We rarely find the organisation happy enough to bestow upon the faculties of a superior order an absolute power of impressing a favourable direction upon the inferior. We may, therefore, admit it as a truth established by the laws of organisation, that, among men, a very small number find in themselves alone sufficient force or motive to be a law unto themselves,—always to resolve upon acts conformable to the dignity of the most noble inclinations, sentiments, faculties of men." (8vo. t. i. p. 320. sqq. See also 4to. vol. ii. p. 133. sqq.)

Gall required Dr. Spurzheim to infuse order, system, and philosophy into his discoveries and views!

He belonged to the small and noble class. God grant that increased cultivation of man's higher cerebral faculties may enlarge it!

indications of treatment will arise from the fact, just as in the latter cases.

We learn how absurd in education it would be to attempt the production of great excellence of a particular kind, on the supposition that he who can excel in one thing can excel in another, as though it were true, in Dr. Johnson's words, that "Genius is general powers applied to a particular subject;" or that, as Mr. Dugald Stewart said, "particular excellence is the result of particular habits of study or of business." We know by phrenology that all cannot do all; that the most unfit for one thing may be the most fit for another; and the organisation will indicate from whom we can expect nothing, and when we may hope for success. Punishment will not be inflicted, nor irksome studies enforced, where nature is at fault and the faculty is not strong enough from deficiency of organ. We are enabled to decide when the pupil is anxious for excellence through good feeling or conceit, and yet cannot by nature succeed in the particular branch which attracts him. We are enabled to adapt our moral management accurately to the moral qualities of each child.

In short, in every thing human, by knowing that various intellectual and moral faculties exist, by knowing what these are, by knowing accurately in general in what positive and relative strength they are supplied to particular individuals, we are enabled to act like philosophers, and not with that ignorant brutality which has hitherto so much disfigured the education and legislation of the world, as well as private conduct in society.

Gall made this noble and philosophical application from the first, as will be seen in both his works.[b] Others make them daily.[c]

By phrenology the true mental faculties have principally been discovered; and, as it shows the true nature of man, its importance in medicine, education, jurisprudence, and every thing relating to society and conduct, must be at once apparent.[d]

[b] l. c. 4to. vol. ii. p. 133—212., 8vo. t. i. p. 319—457., and both works *passim*.

[c] See Dr. Spurzheim's writings; Mr. Combe's *System of Phrenology*, and his *Essay on the Constitution of Man;* Dr. Combe's work on *Insanity;* Mr. Simpson on *Education;* and the *Edinburgh Phrenological Journal, passim.*

[d] I shall end the subject of Phrenology with one of those beautiful passages with which Gall's works abound.

"I have always been conscious of the dignity of my researches, and of the

While the brain is evidently the organ of mind, the nerves united with it, and the spinal chord, together with its nerves, are as evidently the instruments by which it affects, and is affected by the other parts of the body, to which these nerves are distributed. By their instrumentality, the brain contracts the voluntary muscles, influences the functions of every other part when under the operation of the different passions, and receives impressions made upon every other part.[e] The consequences of divisions of the nerves or spinal chord, fully substantiate these points.

If a nerve supplying an organ of sense, as the olfactory, optic, acoustic, or gustatory, is compressed or divided, the organ becomes insensible to odours, light, sounds, or tastes. If one exciting muscles only, as the common motor oculi, — the internal — or the external motor, — the facial — or the hypoglossal, the will loses power over such muscles ; — over the inferior, superior, and internal

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extensive influence which my doctrine will one day exert upon human knowledge ; for which reason I have remained indifferent to all the good or evil which might be said of my labours. They were too far removed from received opinions to be relished and approved at first. A knowledge of them required profound and continued study : every one wished to pronounce upon them, and every one came with opinions and views according to his means of intelligence. All the doctrine is now consecrated to the public. Judgment cannot long remain doubtful. Personal feeling will disappear : the passions will calm, and criticism will have only its due weight. Posterity will not fail to contrast the point from which I started with that at which I stopped. My adversaries have but too distinctly displayed the state in which the various objects of my labours were, for it to be difficult to know what improvement these have derived and will derive from my discoveries. What progress in the comparative anatomy, physiology, and pathology of the nervous system ! What a fruitful source of irrefragable principles for philosophical studies ; for the art of learning the disposition of individuals to the best advantage ; for the art of directing the education of youth ! What valuable materials for criminal legislation, based upon a complete knowledge of the motives of human action ! How history will change in the eyes of those who will know how to value it according to the predominant inclinations and faculties of the personages who have played the chief parts in it," &c. (l. c. 4to. vol. iii. p. xii. sq., 8vo. t. vi. p. viii. sq.)

[e] In strict language, no part of the body but the encephalon, or what corresponds to it in lower animals, can have sensation. The different parts may be so affected, that, by the intervention of nerves between them and the encephalon, the latter perceives the impression made upon them ; but the *sensation* is in the encephalon, although instinctively referred to the spot which is its *source*.

straight muscles of the eyes, the inferior oblique, and the levator palpebræ superioris,—the superior oblique,—the abductor straight muscle, — many muscles of the face, viz. the orbicularis, levator anguli oris, &c. &c. — or the muscular fibres of the tongue. If the spinal chord, or nerves conveying both volition from the brain and impressions to the brain, the supplied parts lose both sense and motion.[f] For when nerves both convey volition and supply common sensibility, as the fifth and the spinal nerves, they are compound, one portion performing but one function, as is proved by separately dividing the anterior and posterior part of the trigeminum, or the nervous bands, proceeding from the anterior and posterior parts of the spinal chord, before their conjunction; when the division of the former deprives the parts supplied of the influence of volition, and that of the latter deprives them of sensation. In the case of either these compound or the simply motor nerves, if the divided surface, now unconnected with the brain, is irritated (or if, indeed, the parts are not divided, but at once irritated by pinching), contractions occur in the muscles supplied by them; and, if a sedative is applied to them, some say that the muscles become inert. In the case of the compound nerves too, and in the case also of the division of those nerves which have common sensibility or touch and constitute a part of compound nerves, if the divided surface connected with the brain is irritated, acute pain is felt, as if in the part on which the nerve originally terminated[g]; and, after the removal of a limb, it is common for uneasy sensations to be experienced by the patient as if he still possessed his hand or his foot. The nerves which convey volition only, and

[f] These facts are too frequently proved to be doubted; and, consequently, four cases, in which the spinal chord is said to have been divided without the effect of paralysis, must be suspected of error. (See Metzer's *Principes de Médecine légale*, translated, with notes, by Ballard, p. 357. sq.) Another has been quoted from Dr. Magendie's *Journal de Physiologie*, t. iii., in which the *arms* were paralysed as to motion, and the lower cervical and upper dorsal chord was a colourless pulp, except two bands between the anterior fissure and the sides; so that the anterior portion of the chord was continuous (p. 184.), though the posterior was destroyed at one part. But the description is imperfect. Dr. Magendie suggests that the membranes carried on sensation!

[g] Thus, after the loss of the glans penis, the extremities of the nerves are sensible to venereal pleasure, as noticed by John Hunter and Dr. Marshall; and I once had an out-patient at St. Thomas's Hospital with gonorrhœa, and only an inch of a remnant of penis.

those of the other four senses than touch,—the nerves of the specific senses,—feel little or no pain when mechanical stimulus is applied; and these generally have not, like those which furnish and possess common touch or common sensibility, and perhaps all those of the specific senses, a ganglion at a certain distance from their origin.[h] There is Gasser's ganglion for the trigeminum, the posterior and larger part of which, including the ophthalmic and superior and inferior maxillary, gives sensibility to the face, and even what common sensibility they possess to the nerves of the specific senses and of motion; while the anterior and smaller part is not united with Gasser's ganglion, and is a nerve of motion to the muscles of the lower jaw, and some others of the face. There is a ganglion for each posterior nerve of the spinal chord.[i] The anterior

[h] See Dr. Magendie's *Précis de Physiol.* t. i. p. 200. sq. ed. 3.

[i] The branch of the trigeminum unconnected with the ganglion was declared to be a nerve of motion only, and to belong to the various muscles of the lower jaw, by Dr. Paletta in 1784: and was, therefore, called nervus masticatorius by Dr. Bellingeri in 1818. (*Dissert. inaug.* Taurini, 1818.) Dr. O'Beirne has shown that the motor portion is more extensively distributed in the muscles of the face; that, after uniting with the inferior maxillary of the ganglionic portion, so that the two are intimately mixed and all the subsequent branches are compound nerves one of which becomes attached to the superior branch of the facial, it is distributed to many muscles of the face besides those of the lower jaw. He hence explains some instances of a certain loss of motion after injury of the ganglionic portion of the fifth, and of continuance of motion after injury of the facial;—paralysis of the motor branch of the fifth being attended by distortion of the face while the patient is at rest, and less when he speaks, laughs, &c. and thus puts in action the muscles supplied by the facial nerve; paralysis of the facial being attended by distortion only when he puts these in action; and paralysis of both being attended by constant distortion and an increase of it during these actions. He shows with great acuteness how unsatisfactory and erroneous are many of Sir C. Bell's views and statements respecting paralysis of the face. (*New Views of the Process of Defecation*, p. 227. sqq.) Dr. Bellingeni appears to have had some vague notion of the functions of the anterior part of the trigeminus and of the facial nerve; but, since he says that the facial nerve gives animal sensibility as well as motion to the muscles and integuments of the face (p. 124.), and speaks of the upper branch of the trigeminus as exciting involuntary motion (p. 177. sqq.), I cannot believe that he anticipated Sir C. Bell, who certainly appears to have discovered step by step the office of the ganglionic portion of the trigeminum, and proved that this was a double pair for sensation and motion — the portion devoted to sensation having a ganglionic enlargement, the other none, exactly like the spinal nerves; although its similarity in structure to the spinal nerves he candidly states to have been pointed out by Prochaska half a century ago, and by Sömmerring. (*The*

portion of the spinal chord is nearly insensible, while its posterior portion, and all the ganglionic branches of the trigeminum, are

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Nerv. Syst. of the Hum. Body, 1830, p. viii. In this work are various papers presented by him to the Royal Society during the preceding nine years.) Sir C. Bell also discovered the facial to be a nerve of motion only, though, besides speaking of it as a nerve of voluntary motion, he gave it some properties of expression which are common to all nerves of voluntary motion, and strangely called it a respiratory nerve. Our knowledge of the functions of the anterior and the posterior or ganglionic portion of the spinal nerves, we owe first to Sir C. Bell, and next to Dr. Magendie. In a tract privately circulated by Sir C. Bell in 1811, he stated that, on dividing the posterior spinal nerves, no motion ensued; but that, on touching the anterior, the muscles of the back were instantly convulsed. (p. xvii. sq.) He concluded that the anterior and posterior portions had different functions, and that the anterior gave motion; but he went no farther: and even fancied that the anterior gave sensibility also, and that the posterior might have other functions altogether. Dr. Magendie, many years later, proved that the anterior nerves gave motion only, and the posterior sensation. (*Journal de Physiologie*, t. ii.) Had Sir C. Bell been aware of these, — the true functions, — he would not have neglected to set forth a discovery which he views in his later writings as so great.

While a branch of the trigeminum was supposed to be a nerve of taste — a special sense, — there was a great want of uniformity in our views of its offices. It resembled the spinal nerves, in having a ganglionic and an aganglionic root. The aganglionic had been shown by Paletta to be for motion only. Every body knew that the ganglionic portion was for sensation. For example, Blumenbach said, when treating of smell, that the first pair was for this sense, but the trigeminum for the common sensibility of the nostrils. Still the ganglionic portion was thought to be a nerve of motion also, and this was Sir C. Bell's opinion; for his first experiment seemed merely to corroborate the common belief, that the ganglionic portion was for sensation and motion. After he had made many experiments he concluded it was for sensation only, and, although he is right in regarding it as a nerve of sensation only, he and others appear incorrectly to ascribe a number of facts regarding paralysis of motion in the face to the seventh, that really depend upon the trigeminum, though not upon the ganglionic portion but upon the aganglionic portion, as Dr. O'Beirne has so well shown. In fact, the truth of the ganglionic portion of the trigeminum being for sensation only was in some measure incorrectly inferred by Sir C. Bell from his experiments and cases, exceptions being passed over or unsatisfactorily explained. They all admit, however, of easy explanation, by referring impairments of motion on dividing the ganglionic branches to the extensive ramifications of the aganglionic portion in conjunction with those of the inferior maxillary branch; and, where any paralysis of motion appeared on dividing the superior maxillary branch, to the necessary injury of one head of the levator labii superioris alæque nasi. From reviewing every circumstance, there can be no question that Sir C. Bell's view, of the ganglionic portion being for sensation only, is true. Still he has left

acutely sensible: the division of the former portion has the same effect as the division of the anterior nerves; of the latter, as the division of the posterior nerves. The destruction of the centre of the spinal chord by a wire impairs neither sensation nor motion[k], nor is pain felt by the experiment: and I may remark that, in experiments on the healthy cerebrum and cerebellum, no

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the matter confused and anomalous, by assuming the general belief of a branch of this nerve of common sensation or touch serving for a special sense, — for taste. The perfect analogy of the trigeminum to the spinal nerves in having one of its two divisions for common sensation only and one for motion is now established by Professor Panizza, through his demonstration of the glosso-pharyngeal being the nerve of the special sense of taste, while the branches of the trigeminum going to the tongue are for its ordinary sensibility, just as those which go to the mucous membrane of the nose endow it with the same common sensibility, while the olfactory endow it with its special sense of smell. (See *infrà*, Chapter XXI. On Taste.)

Dr. Magendie, finding that the division of the trigeminum deprived the nose, eyes, &c. of the sense of touch, so that acrid substances no longer irritated, concluded that it gave smell, sight, and taste, and threatened to overthrow the doctrine of the optic nerve being for sight, the olfactory for smell, and so on. He mistook the loss of common feeling for the loss of the specific sensibility of the eye, nose, &c., and his conclusions have long fallen to the ground.

The opinion that there are distinct nerves for sensation and for motion had been entertained ever since the time of Erasistratus by many writers, from the fact of paralytic limbs being sometimes deprived of sensation only, sometimes of motion only, or even, in the latter case, becoming more sensible than previously. In Pouteau's *Œuvres Posthumes*, published in 1783, vol. ii. p. 532., it was maintained, but the author remarked that it had long been abandoned by anatomists. He erred in supposing that the nerves of sensation came from the cerebrum, and those of volition from the cerebellum: as Galen erred in saying that the nerves of sensation arose from the brain, and those of voluntary motion from the spinal chord. Certain nerves were known to be for sensation only, as the olfactory, optic, and acoustic; some for motion only, as the common motor of the eye, the external and internal motor. Sömmerring had pointed out that one nerve gave motion to the tongue, another sensation: whence a man might lose his taste and yet move his tongue as before (*Hirn und Nerven*, p. 255.); and Gall, in 1810, urged that his adversaries would find it difficult to prove that the same nervous filament possessed the power of both feeling and motion; and that the trigeminum pair, which supplies both sense and motion, has three distinct roots. (*Anatomie et Physiologie*, t. i. p. 129. sqq.) The morbid sensibility to warmth occasionally observed in paralysis, although the sense of touch be not morbidly acute or be actually impaired, induced Dr. Darwin to fancy there were distinct nerves even for the sensation of temperature. (*Zoonomia*, Sect. xiv. 6.)

[k] Dr. Magendie, *Journal de Physiol.* t. iii. p. 153. sq.

sign of sensibility appears on cutting the former to a great depth, or the latter superficially. But the division of the trigeminum, on the sides of the fourth ventricle, has all the effects of its division without, and severe pain attends injury of the interior and sides of the fourth ventricle[l], except as you approach the anterior part of the spinal chord; and there is little sensibility at the corpora quadrigemina. The effects of the division of the spinal chord are of course more extensive in proportion as the division is made higher up; and, if made above the origin of the phrenic nerves, which are the chief agents in causing the contraction of the inspiratory muscles, and consequently above the origin of all the nerves of inspiration, death immediately ensues.[m] Yet, in brutes, after removing the head or dividing the spinal chord, if any limb is irritated, its muscles are thrown into action: thus Sir Gilbert Blane, after such operations in kittens a few days old, found the hind legs to shrink from the touch of a hot wire applied to the hind paws; and the tail to move when irritated, after the division of the chord below the last lumbar vertebra.[n] More divisions than one do not prevent this effect. If the head of a pigeon is cut off, and the whole brain removed except a portion to which the third pair is attached, and the optic nerve is divided, the iris instantly contracts when the extremity of the optic nerve is pinched.[o] Dr. Macartney says that contraction of the iris occurs from light suddenly admitted to the retina after the head is cut off or the eye taken out.[p] Dr. Magendie also remarks that, when the posterior roots of the spinal chord are irritated, besides signs of extreme pain, the muscles below the part irritated are thrown into action, but only on the same side of the body. All these facts show a peculiar relation between the nerves of

[l] Dr. Magendie, *Précis*, t. i. p. 237. 3d edit.

[m] It is thus that animals are every day killed by pithing; in Germany I have never seen oxen killed in any other way: a blow on the back of the neck is sufficient to destroy rabbits. Livy informs us that, at the suggestion of Asdrubal, in the battle in which he was slain, when the Carthaginian forces were routed, and their elephants became unmanageable, the drivers destroyed them in a moment by one blow of a hammer upon a knife fixed between the junction of the head and spine. (*Histor.* l. xxvii. c. 49.) The division of the phrenic nerve only does not put a stop to respiration. See for instance, Bichat, *Recherches Physiol.* p. 327.

[n] *Select Dissertations on several Subjects of Medical Science.* By Sir Gilbert Blane, Bart. M.D. London, 1822. p. 262.

[o] Mr. Mayo, l. c. p. 231.

[p] *Report of the Third Meeting of the British Association*, 1834, p. 53.

sensation and motion that originate at the same portions of the nervous system.[q]

If the chorda oblongata exists, consciousness and volition become evident. Mr. Lawrence saw a child with no more encephalon than a bulb, which was a continuation for about an inch above the foramen occipitale from the chorda spinalis, and to which all the nerves inclusively from the fifth to the ninth pair were connected.[r] The child's breathing and temperature were natural; it discharged urine and fæces and took food, and at first moved very briskly, and lived four days. M. Lallemand saw such another which lived three days, and cried loudly.[s] M. Ollivier one which not only cried and sucked, but squeezed strongly what was put into its hand.[t] Unfeeling vivisectors, however, have not been contented with such facts supplied by nature, but have repeated them by the knife, and found that, if the cerebrum and cerebellum are removed in a living mammiferous brute, and the same portion of the chorda oblongata left, the poor thing cries on attempts being made to give it pain by pulling its whiskers or applying pungent things to its nose or mouth, and it moves its extremities, in order to escape from its annoyances, sometimes for two hours.[u] An adult hedgehog gratified Dr. Magendie by doing all this for two hours. Cold-blooded animals live much longer; and, the lower we descend in the scale of brutes, the more diffused appear the powers of the nervous system: indeed, in the lowest there is, strictly speaking, no brain nor spinal chord, but nervous granules, or distinct ganglions and nerves,

[q] *Journal de Physiologie*, t. iii. p. 154.

Dr. Magendie, with Desmoulins, asserted that the spinal nerves of the python thus sprang from but one root. But Mr. Mayo found them arise from two, as in all the vertebrated animals. (*Outlines*, p. 254.)

[r] *Medico-Chirurgical Trans.* vol. v. p. 166. sqq.

[s] *Obs. Path.* p. 86.

[t] *Traité de la Moelle Epinière*, p. 155.

[u] *Anatomie du Syst. Nerv.*, par MM. Magendie et Desmoulins, p. 560. Dr. Magendie, for whose head the dogs, cats, and rabbits of France would in his active days have offered a reward, if they had known their own interest, says, "It is droll to see animals skip and jump about of their own accord, after you have taken out all their brains a little before the optic tubercles." And as to "new-born kittens," he says, "they tumble over in all directions, and walk so nimbly, if you cut out their hemispheres, that it is quite astonishing." (*Journal de Physiologie*, t. iii. p. 155.) Above a century and a half ago, — in 1673, M. Duverney removed the cerebrum and cerebellum from a pigeon, and found the animal "live for some time, search for aliment, &c." (*Phil. Trans.* vol. xix.)

which, no doubt, perform the same functions as far as required in those animals, and are, in fact, some at least, brains also to them, but of a different form and accommodated to their structure.[x] In the same way the heart is not one mass in the cuttle-fish but three, and in the lowest none exists,—vessels carrying on the circulation. It was, not many years ago, customary to assert that many animals have no nervous system. "It was reserved for the modern spirit of observation," says Professor Tiedemann, "to establish the presence of nerves in many of the most inferior animals—the star-fish, actinia, pyrosoma, ascidia, and some entozoa, in which their existence was denied in Haller's time."[y] Professor Ehrenberg has lately shown that the infusory animalcules possess nerves and even ganglia, as well as eyes, muscles, and sexual and digestive organs, and probably vessels, though myriads can exist in a dot: the verticella rotatoria being only from $\frac{1}{300}$ to $\frac{1}{400}$ of an inch in dimension.[z] In regard to brutes in which nerves are not yet found, Dr. Tiedemann allows that, "as we perceive in these animals phenomena which take place by the medium of nerves in animals of a more elevated order — that is to say, sensibility and voluntary motion — it is not improbable that, in them, the nervous substance is mixed with the gelatinous or mucous mass, without being demonstrable as a particular tissue."

The higher we ascend, the more parts exist above the chorda oblongata, till, rising from fish and reptiles, through the numerous warm-blooded brutes, all distinguished by the relative magnitude of each cerebral part, according to their several mental characters, and seeing the successive additions of cerebral structure and cerebral mass, and of intelligence, we arrive at man, in whom the successive impositions of cerebral matter has reached its maximum, so that the summit of the nervous system, which corresponds with the forehead and vertex, is much larger in him than in any brute[a], and his intellect and moral feelings are proportionally

[x] Gall, l. c. 8vo. t. i. p. 25. sqq.

[y] *Systematic Treatise on Comparative Physiology*, by F. Tiedemann, M.D. Prof. of Anat. and Phys. in the Univer. of Heidelberg, translated by G. J. M. Gully, M.D., and J. H. Lane, M.D. 1834, p. 64. See my remarks, *suprà* [e], p. 4.

[z] See accounts of Prof. Ehrenberg's discoveries by Dr. Gairdner, and my colleague Prof. Sharpey, in the *Edin. New Philos. Journal*, 1831, 1833.

[a] See Gall, l. c. 4to. vol. ii. p. 252. 364. sqq.; 8vo. t. ii. p. 153. sqq. 365. sqq., t. vi. p. 298. sqq.

greater.[b] According to the smallness of the anterior and anterior-superior portions of the brain, will individual mental superiority to the brute creation be small. Human idiotism may arise from faultiness of texture, or want of power [c], but most congenital cases depend upon deficiency of anterior development; and such idiots, as well as the whole brute creation, may be regarded as examples of cerebral mutilations, made by nature, illustrating the use of the cerebral parts. Attempts to mutilate artificially are not calculated to afford much information. Brutes can generally give no opportunity of minutely observing what mental change has been produced by the removal. For instance, when a writer says that the removal of the cerebellum causes no other effect than sluggishness in the animal, — how does he know that sexual desire is not extinguished? When various portions of brain are removed, how can any inference be drawn, during the short existence of the poor animal, as to the state of its various faculties and inclinations? And when another asserts that, after the removal of the hemispheres and cerebellum, we may make observations whether the animal will copulate or not, how can he ascribe the disinclination that may occur to the removal, when any circumstances of suffering,—a wound, confinement, or want of food,—will make it very difficult to induce an animal to indulge itself with sexual intercourse?[d] It is, besides, difficult, if not generally impossible,

[b] In the words of the 94th Number (already quoted above at p. 329.) of the *Edinburgh Review*, now retracting its assertions: "In the nervous system alone we can trace a gradual progress in the provision for the subordination of one animal to another, and of all to man; and are enabled to associate *every faculty which gives superiority with some addition to the nervous mass*, even from the smallest indication of *sensation* and *will* up to the highest degree of *sensibility*, *judgment*, and *expression*. The brain is observed to be progressively improved in its structure, and, with reference to the spinal marrow and nerves, augmented in volume more and more, until we reach the human brain, each addition being marked by some addition to, or amplification of, the powers of the animal, until in man we behold it possessing some parts of which animals are destitute, and wanting none which they possess."

[c] Gall, 8vo. t. ii. p. 377.

[d] See Gall, l. c. 8vo. t. vi. p. 210. From page 178. to 288. are excellent remarks upon the unsatisfactory nature of such experiments as have been made by Fleurens, Rolando, &c. &c. See also 4to. vol. iii. p. 56., and 8vo. t. iii. p. 379. sqq. The first three quarters of the sixth volume should be read by all who are acquainted with the writings of these experimenters, or of Tiedemann, Rudolphi, Serres, &c. upon the brain. They will find those writers less meritorious than they imagined.

to remove one cerebral organ entirely and alone. Other parts of the encephalon, &c., are almost certain to be injured[e]: and, if

[e] "Where is the anatomist or physiologist who precisely knows all the origins, the whole extent, all the ramifications, all the connections of an organ? You remove the cerebellum, at the same moment you severely injure the medulla oblongata and spinalis, you injure the tuber annulare, you injure the tubercula quadrigemina; consequently, your results relate not merely to all these parts, but to all those which communicate with them, either directly or indirectly. You think you have insulated the tubercles, but these tubercles have connections with the corpora olivaria, the medulla oblongata, the cerebellum, the sense of vision, and many convolutions; the thalami, optici, the corpora striata, are connected below with the crura cerebri, the tuber annulare, the medulla oblongata, the pyramids, and the spinal marrow; above, with all the cerebral membrane, all the convolutions, the non-fibrous, grey, substance of their surface, with the different commissures, as the anterior commissure, the great commissure or corpus callosum; with the fornix, the septum lucidum. Thus there does not exist a cerebral part which we do not know to have numerous connections with other parts. I do not except even the corpora mammilaria, the pineal gland, the infundibulum, &c. The connections yet unknown are unquestionably still more numerous." (Gall, l. c. p. 240. sqq.) Sir C. Bell has lately imitated Gall in objecting to vivisections as a means of discovery.* Gall's nature was most tender. He had a horror of inflicting pain upon poor brutes, and would allow Dr. Magendie to be little more than a canicide. He always kept birds and dogs in his house at Paris; and I have seen him kiss his horses on alighting from his carriage at his country house, and then stand to receive the caresses of several immense bloodhounds which put their fore legs upon his shoulders. (See his glowing remarks on cruelty to brutes, l. c. 4to. vol. iv. p. 196., 8vo. t. v. p. 259. sq.)

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* *Phr. Trans.* 1834. No doubt in complete ignorance of Gall's writings, because he says that "not one of the great divisions of the brain has yet been distinguished by its function," and alludes evidently to Gall's physiological discoveries as the "weakest fancies that ever obscured any science." He had said before that Gall's strictly inductive method "is the most extravagant departure from all the legitimate modes of reasoning;" that Gall, without comprehending the grand divisions of the nervous system, without a notion of the distinct properties of individual nerves, or having made any distinction of the columns of the spinal marrow, without having ascertained the difference of cerebrum and cerebellum, &c. (*Ph. Tr.* 1823.) Sir C. Bell must be in total ignorance of Gall's works, more especially as he adopts some of Gall's facts without mentioning his name. His folly as been exposed by Dr. Spurzheim (*Appendix to the Anatomy of the Brain.* 1830. p. 23. sqq.) It is delightful to find that, even in 1823, Sir C. Bell was harassed by the popularity of Gall's discoveries and the difficulty of keeping his pupils from being converts to phrenology. (*Nervous System*, p. 122.) We phrenologists, however, must console ourselves with reflecting that his ignorance is not confined to Gall's labours, as he disfigures the *Philosophical Transactions* (1834, p. 471.) by speaking of "*a* minute spicula."

others should not be injured, they may be influenced by the extension of the irritation from the injury[f], and by sympathy with the injured parts; just, for example, as we see epilepsy from exciting causes in every part of the encephalon and from exciting causes even in distant organs; amaurosis is frequently induced by wounds of the supra-orbital nerve, sometimes by wounds of the infra-orbital nerve, and of the portio dura[g]; M. Fleurens declares that, in cutting the semicircular canals in which the acoustic nerves only are spread, peculiar motions occurred. If the horizontal canal on each side was divided, horizontal movement of the head took place from side to side, and rotation of the whole body. Division of the inferior vertical canals on each side produced vertical movements of the head, and caused the animal to lie on its back. Division of the superior vertical canals caused vertical movements of the head, but the animal lay forwards. The direction of the inferior vertical canal is backwards, and of the superior forwards. If all the canals were divided, all sorts of violent motions took place.[h] Some parts which have distinct names are only portions of organs, so that injury of several parts may have the same effect; — we may have blindness from wounding the optic nerves, the tractus optici, or the corpora quadrigemina. Some parts which have distinct names are compound, so that the immediate and obvious effect of injuring them is not the only consequence which would be observed if the others had an opportunity of becoming apparent. The chorda oblongata is an instance of this[i], and all the double nerves of sensation and motion.[k]

[f] See Gall, l. c. 8vo. t. iii. p. 409. sqq., where examples are given.

[g] See many cases in Mr. Wardrop's work, *On the Morbid Anatomy of the Eye*, vol. ii. p. 179. sqq. The fact is even mentioned by Hippocrates; and, what is singular, the blindness generally arises from an imperfect division of the nerve, and has been cured by making the division complete. The blindness has sometimes taken place instantly, sometimes come on very gradually.

[h] *Mém. de l'Acad. des Sc.* t. ix. p. 454. sqq.

[i] "The tubercula quadrigemina are a continuation of the bands of the medulla oblongata and medulla spinalis. They are also formed by ganglia, one portion of which gives origin to the fibres of the optic nerve.

"In the same manner, the medulla oblongata is in a great measure a continuation of the spinal marrow, besides containing many collections of non-fibrous substances, which, like so many ganglions, are the origins of many nerves of the highest importance, and relating to very different functions.

Hence the contradictory and strange observations and inferences of most experimenters on the brain of living brutes.[l] The

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" The tuber annulare is not only composed of the nervous bundles of the two hemispheres of the cerebellum, or of the commissure of the cerebellum, but is also a continuation of several bundles of the medulla oblongata and spinalis, of the anterior and posterior, or inferior and superior, pyramids, and contains a considerable quantity of non-fibrous substance interposed between the transverse and longitudinal bundles, and giving rise to fresh filaments for the crura cerebri, the tubercles," &c. (Gall, l. c. 8vo. t. vi. p. 243. sq.)

[k] " You cannot insulate even the nerves of sensation before they are complete. The origin of the nerves of taste is confused with the masses of the origin of many other nerves; the auditory is confused with the nervous and non-fibrous masses of the fourth ventricle; the optic nerves at first with all the mass of the tubercles, with the corpora geniculata and their attachments, with the crura cerebri, with the grey layer situated immediately behind their junction. The olfactory nerves are at first intimately connected with the grey substance placed upon the interior and inferior convolutions of the middle lobes, with the anterior cerebral cavities," &c. (l. c. 8vo. t. vi. p. 245.)

[l] Fontana says that, after removing the brain of a turtle and entirely emptying the cranium, the animal lived six months, and walked as before. M. Rolando attempted the experiment repeatedly, but the animal always died as soon as a cut was made behind the cerebellum.

M. Rolando says that he " made innumerable experiments upon goats, lambs, pigs, deer, dogs, cats, and guinea-pigs, to ascertain the results of lesion of the tubercles, and parts near the optic thalami, but rarely obtained the same results." M. Rolando says that lesion of the thalam optici causes convulsions; M. Fleurens denies it. (Gall, l. c. t. vi. p. 191.) M. Rolando found an unsteadiness like that of intoxication follow the removal of two thirds of the lobes of the cerebrum from a chicken. M. Fleurens declares that he must have wounded the cerebellum. M. Fleurens protests that the results of the experiments of M. Rolando are contradictory to each other (p. 215.): and, after finding a chicken walk, fly, and swallow, shake its wings, and clean them with its beak, subsequently to losing the hemispheres of its brain, infers that these are the residence of the understanding and feelings, and that the cerebellum is destined to balance, to regulate motion; yet birds, after losing these parts, pecked and clawed their enemies, and perched. (p. 266.) M. Rolando considers muscular action to depend upon the cerebellnm; yet Dr. Magendie found animals perform regular motions after losing it.

In the *Report of the Physiology of the Nervous System*, read at the British Association in 1833, in which Gall's name is not once mentioned, the compiler, after saying, " But there *does* appear sufficient evidence to prove that those volitions, which have motion for an effect, whatever be their origin, whether in the cerebrum, cerebellum, or medulla oblongata, require for their accomplishment the co-operation of the cerebellum," declares further on, that " a duck, whose cere-

same effects moreover do not occur in the same experiments upon different species of animals. The observation of nature's own mutilations in brutes which have little or no development of parts that are large in others, or in man, is therefore preferable; and next to this comes the observation of morbid changes of different parts,—a subject, however, incapable of affording information till the faculties had been ascertained by Gall. (See *suprà*, p. 349. sqq.) Still some results of mutilating the living brain appear generally allowed, and are not at all in contradiction to phrenology. The experiments of M. Fleurens are allowed by Gall to be very ingenious, and sometimes satisfactory[m]; and, with respect to injuring the cerebellum, Gall remarks, "we must never forget that the same part may have its general vital function and its particular animal function. If it is true that the lesion of the tubercles in birds always causes convulsions, it is not less true that the tubercles are destined to vision; and in the same way the cerebellum (connected as it is with the medulla oblongata, &c.) may participate in the vital function of the medulla oblongata and spinalis, may give rise to disturbed motion when injured, and yet have its

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bellum had been destroyed," by Dr. Magendie, "swam backwards,—could swim only backwards" (p. 69.): and Dr. Magendie shows that it is requisite to neither sensation nor motion; for, when, after having robbed hedgehogs and guinea-pigs of their cerebrum and cerebellum, he kindly held a bottle of refreshing vinegar under their nostrils, they rubbed their little noses with their paws! And he says that he has over and over again seen animals performing very regular movements after he had disburthened them of the whole of their cerebellum. (*Précis*, t. i. p. 408.) In opposition to M. Fleurens, MM. Foville and Pinel Grand-Champs ascribe to the cerebellum the function of sensation.

M. Fleurens, after removing the cerebrum, declared all sensation and volition to be lost. M. Bouillaud found animals so deprived give signs of pain and exert will in endeavouring to escape. (Dr. Magendie's *Journal*, t. x. p. 36. sqq.) M. Fleurens infers that the lobes of the cerebrum concur as a whole in their functions, and that, when one sense is lost, all are lost. But M. Bouillaud, on removing the anterior lobes, found that dogs, rabbits, pigeons, hens, saw, smelt, and moved voluntarily; but were indifferent to familiar sounds, persons, places, or things. In fact, he found Gall's assertion true, — that, though sensation was independent of the anterior part of the brain, the faculty called by Gall sense of things (objects as wholes), and those of language, places, and persons, were altogether dependent upon the anterior part. The result of M. Bouillaud's experiments made him a strenuous phrenologist.

[m] l. c. t. vi. p. 249.

own particular animal functions."[n] That animals should skip and jump, and eat, after losing their hemispheres, is not surprising, if these parts perform the phrenological functions assigned to them and are not necessary to motion. The chorda oblongata and other lower parts of the encephalon have, no doubt, much to do with motion as well as the chorda spinalis. Accordingly, when the oblongata was pressed in the child mentioned by Mr. Lawrence convulsions occurred; and the same effect ensued on irritating it, in Gall's experiments and those of Lorry.[o] Pressure of it, however, is also said by vivisectors to occasion stupor.

Dr. Magendie, who cut living animals here and there with no definite object, but just to see what would happen, informs us, that,

1. Deep cuts of the hemispheres do not affect motion in mammalia, reptiles, fish, and many birds, any more than their entire removal: but the latter is said to occasion blindness in mammalia and birds, though not in fish or frogs, probably from the arrangement of the cerebral parts being different, so that a similar wound affects different organs. Neither a longitudinal section of the mesolobe, nor its removal, has any more effect on motion.

2. If the *white* substance of both corpora striata is cut away with the hemispheres, the animal darts forward against all objects in its way, and retains the attitude of progression, if prevented.[p] If the injury is to the grey portion, or to the white of one corpus striatum only, motion is not interfered with. When a thalamus was removed from a poor animal moving forwards after this mutilation, it ceased to attempt advancing, but began to turn to the corresponding side; and, when the other thalamus was next cut away, it became still, with its head inclined backwards.[q] M. Fodéra had found that the removal of a part of the cerebellum

[n] l. c. t. iii. p. 385. sq. Dr. Vimont also conceives that the cerebellum is not simple. Finding its processus vermiformis very large in climbing and remarkably sure-footed animals, he imagines that it will be found somehow connected with motion. (l. c. t. ii. p. 242.) 1835. Mr. S. Solly lately stated to the Royal Society that he has traced a superficial and a deep-seated layer of fibres from the anterior columns of the spinal chord into the cerebellum.

[o] Gall, 8vo. l. c. t. iii. p. 392.

[p] Yet Drs. Foville and Pinel Grand-Champs fancied that the anterior lobes and corpora striata presided over the motions of the inferior extremities; and the posterior lobes and thalami over those of the superior.

[q] *Report of Brit. Assoc.* 1833.

always caused motion backwards, or a corresponding attitude. Injuries of one side of it paralysed the same side of the body, as the fibres of the restiform bodies do not decussate like the anterior pyramids.[r] But Dr. Hertwig asserts that injuries of the cerebellum affect the opposite side, just as Gall found removal of the testis affect the opposite lobe of the cerebellum. Dr. Magendie often found animals perform very regular movements after the removal of the cerebellum; yet he observed that the removal and wounds of it to a certain depth, and of the chorda oblongata[s], gave mammalia and birds a tendency to move backwards, though the same effect does not occur in fish, which, after the loss of their cerebellum, swim as usual.

3. In a vertical section of a crus of the cerebellum, or of the mesocephalon from before backwards, the animal immediately rolled forcibly towards the same side, making sometimes sixty revolutions in a minute; and the corresponding eye was directed forwards and downwards, the other backwards and upwards. After the division of a crus, animals continued rolling, and with their eyes thus directed, for eight days. If both crura were divided, all motion ceased, and the eyes resumed their natural state.[t] A similar vertical section downwards of the cerebellum from before backwards half way on one side of the central line, through the whole substance of the arch over the fourth ventricle, or of the mesocephalon upwards, had the same effects, and the motion was the more rapid as the section was nearer to the mesocephalon. When an incision of one half of the cerebellum had set an animal rolling to that side, an incision of the opposite crus arrested the rolling and caused the eyes to resume their natural position. A vertical incision downwards in the median line of the cerebellum caused the animal to attempt motion, but deprived it of the power of balancing itself. Its eyes rolled and started, and its fore legs were rigid and extended forwards.[u]

4. If the fourth ventricle is exposed and the cerebellum removed, a perpendicular incision in the chorda oblongata on one side

[r] *Journal de Physique*, July, 1823.

[s] If ever he amused himself by sticking pins in the chorda oblongata of pigeons, the birds thus ornamented by him would walk and fly backwards for above a month! (*Précis*, t. i. p. 409.)

[t] *Journal*, t. iv. p. 403.

[u] *Journal de Physiol.* t. iv. All these points were ascertained on noticing the effect of a wound made unintentionally in a crus.

of the median line, near the outside of the anterior pyramid, will cause a rabbit four months old to turn to the right, if made on the right side; and to the left, if made on the left.

5. Notwithstanding the decussation of the anterior pyramids, a division of one or both had no sensible effect, except, perhaps, that of retarding motion a little; the section of the corpora restiformia does not seem to affect general motion; and a complete division of one half of the chorda oblongata neither affects sensibility nor prevents irregular motions, though the power of volition appears lost on the same side.

The same phenomena occur in disease. Persons labouring under hysteria or chorea sometimes reel violently or spin round.[x] Persons have been known to feel an impulse to move forwards or backwards.[y] An infinite variety, however, of extraordinary and regular movements also occur, and frequently vertigo attends them, whatever their variety. Vertigo cannot be their cause, as they are so various in different cases, and they or it frequently exist alone.

From these experiments I draw no inference. The considerations already mentioned prevent me from concluding that the parts which are cut are the sole organs concerned in giving origin to the peculiar motions, that their sole purpose is for such motions, or even that peculiar motions depend originally upon them. We can only say, as in the undoubted and numerous cases of amaurosis following an injury of the supra-orbital or infra-orbital nerve, and as in regard to the peculiar motion said by

[x] See *Med. Chir. Trans.* vol. v. p. 1. sqq., also vol. vii. p. 237. sqq.

M. Serres mentions a drunken shoemaker who spun round till he died, and in whom the only morbid appearance was disease of a crus cerebelli. (Dr. Magendie's *Journ.* t. iv. p. 405. sq.)

[y] In a man who had an irresistible desire to move forwards, tubercles were found particularly at the anterior part of the hemispheres. (Dr. Magendie, *Journal de Physiol.* t. iii.) I have seen several epileptic youths with this propensity. They would walk away to a very considerable distance, without knowing why; and this repeatedly. A hemiplegic young man would walk upwards of 50 miles from home, and be lost for a considerable time. I frequently see persons with a propensity to precipitate themselves forwards. In some there is desire merely to leave their abode, and they walk to gratify this, or travel by some conveyance. Dr. Laurent exhibited a girl at the Académie Royal de Médecine, who, in irregular hysteric attacks, rushed rapidly backwards. (Dr. Magendie, *Précis de Phys.* p. 409. sq.)

M. Fleurens to occur on division of the branches of the acoustic nerve, that such effects ensue. In hemiplegia, disease is frequently found in a corpus striatum; and some have endeavoured to prove that paralysis of an upper or lower extremity is attended by disease in this part or that, but the coincidences are not such as to warrant any conclusion.

In fœtuses full grown, without encephalon or spinal chord [z], the circulation, nutrition, secretion, &c. proceed equally as in others, which, besides spinal chord, nerves, and ganglia, possess a brain.[a] These mutilations by nature are conclusive, and render all vivisections on the points unnecessary. Further, the heart and arteries are formed in the fœtus before the encephalon and spinal chord, and therefore cannot depend on them for power and excitement. Vegetables absorb, assimilate, circulate, secrete, and in many instances contract on the application of stimuli, and yet are not

[z] See Morgagni, *Ep.* 48. No. 50.; Van Horne, *Curios. Miscell.* Dec. 1. an. 3. obs. 129.: Kerkring, *Spic. Anat.* obs. 23.; Littre, *Hist. de l'Acad. des Sciences*, 1701, p. 24.; Mery, l. c. 1712, p. 38.; Fauvel, l. c. 1711, p. 26.; Sue, l. c. 1746; M. Roux, *Mém. sur l'Anencéphalie*, 1825; all quoted by Dr. Brachet, *Recherches Expérimentales sur le Système Ganglionaire*. Paris, 1830, p. 83. sqq. p. 69. sqq., for instances of the absence of the spinal chord.

Also, *Phil. Trans.* 1775.

Brainless fœtuses are not uncommon.

A fœtus attached to another has been minutely described by Dr. Mayer of Berlin, in Graefe's *Journal*, t. x., without brain, spinal chord, or encephalo-spinal nerves. There was one nervous twig accompanying the renal artery, and arising apparently from the renal plexus, which, with the mesenteric, existed and had ganglia.

Imperfect fœtuses have been seen, with some organs evolved, though not even nerves could be discovered. See *Phil. Trans.* 1793. See on this subject the excellent remarks of Dr. Marshall, in his works edited by Mr. Sawrey in 1814, and already quoted.

[a] " A girl lived to the age of eleven years, with the use of her senses, and with voluntary motion, weak it is true, but sufficient for her wants, and even for progression." " After death no cerebellum nor mesocephalon could be found." (Dr. Magendie, *Précis*, t. i. p. 414., and *Journal*, t. xi.) Here was one of Nature's own mutilations, without mechanical injury or disturbance of other parts; and, with patience till it occurred, a multitude of innocent animals would have escaped cruel and disgusting vivisections, and an attempt would not have been made to prove that the cerebellum was necessary to motion or secretion, or to prevent involuntary motions backwards.—The girl had prurigo pudendi, and frequently scratched herself. Some antiphrenologists therefore inferred that she masturbated and showed sexual desires, although she had no cerebellum!

thought to possess nerves. I cannot but believe the blood possessed of vitality; and, if it be not, still a clot of fibrine spontaneously becomes vascular without the aid of nerves, though they may be subsequently produced. Muscles, after the division of the nerves which connect them with the encephalon or spinal chord, contract equally as before, when irritated; nay, if they are over-excited by any means and exhausted, and are then allowed repose, they absolutely recover themselves and obey the stimulus again. In animals liable to torpor, the season of torpidity produces its effects equally upon those muscles whose encephalo-spinal nerves have been divided, and equally if the encephalon and spinal chord, &c. are destroyed. In sleep and even coma, the action of the heart, &c. continues; and, even after the removal or gradual destruction of the encephalon, spinal chord, or encephalo-spinal nerves, the heart still continues to act and the blood to circulate, provided respiration is artificially supported[b], — for respiration depends upon the excitement of the muscles by means of nerves of motion springing from the cervical portion of the spinal chord, and these nerves are excited through the sensation of the want of respiration, conveyed to the chorda oblongata, as Dr. Brachet makes probable, by the pneumonogastric pair, which appears to give sensibility to the pharynx, larynx, œsophagus, stomach, and lungs[c], — parts in all

[b] Duverney, whose experiments on a pigeon in 1673 I mentioned at page 421., also removed the cerebrum from a dog, without a fatal result for some time: the removal of the cerebellum was instantly fatal. Yet, by instituting artificial respiration, he sustained life for an hour after the removal of the cerebellum. In one experiment, the dog "lived twenty-four hours, and his heart beat well." The instantly fatal result of the division of the spinal chord he prevented also by artificial respiration, and found that the motion of the heart continued and the animal could move his body. (*Phil. Trans.* vol. xix.)

Spallanzani removed the brain, without injury to the organic functions. (*Expériences sur la Circulation:* ouvrage traduit de l'Italien, p. 377. Généve, 1783.) Fontana injured the brain and spinal chord with no more effect. (*Sur le Vénin de la Vipère*, Florence, 1781, t. ii. p. 169.)

Experiments, &c., by A. P. Wilson Philip, M.D., and Wm. Clift, *Philos. Trans.* 1815.

Also, *Experimental Inquiry*, by the former. London, 1826. 3d edit. Dr. Brachet has lately repeated these experiments upon warm and cold blooded animals. (*Rech. Expér.* p. 73. sq.)

And lastly, Fleurens, *Mémoires de l'Acad. des Sc.* t. x. 1830.

[c] Dr. Le Gallois (*Expériences sur le Principe de la Vie*, p. 247. sqq. 1812) first pointed out that a perfectly anencephalous fœtus cannot live after birth,

which sensation is most important. All the organic or nutritive functions proceed: nails grow, wounds heal, vesicatories

— that respiration will not take place without the portion of the chorda oblongata connected with the pneumono-gastric. The pneumono-gastric are also nerves of motion to the larynx and trachea; and are distributed to the liver, spleen, kidneys, and duodenum, — probably to convey impressions to them from the brain under emotion, and to give them sensibility enough for sensation under causes of great irritation.

The pneumono-gastric on each side gives off, 1. The superior laryngeal, which runs to the membrane of the glottis (see Mr. Swan, *On the Nerves,* plate xvi., Expl. of Plates, p. xlviii.), and therefore gives it sensibility, and to the arytenoid muscles which close it, as well as the crico-thyroid muscle which raises the cricoid cartilage. (Dr. Magendie, *Mém. sur l'Usage de l'Epiglotte dans la Déglutition, &c.*)

2. Twigs to numerous parts in the neck, to the facial, lingual, and three upper cervical nerves, to the cardiac plexuses, the pulmonary plexuses, and the sympathetic nerve.

3. The inferior laryngeal or recurrent nerves (see Mr. Swan, l. c.), which supply "the membrane of the trachea as high as the membrane covering the posterior part of the cricoid cartilage," and the transverse fibres at the back of the trachea, "and ultimately divide into branches which terminate in the lateral crico-arytenoid and thyro-arytenoid muscles," (see papers by Dr. H. Ley, *Lond. Med. Gazette,* June 20. 1835,) besides giving branches of communication with many other nerves. On account of their supplying the membrane of the glottis, Dr. Brachet found that, after removing a portion of the pneumono-gastric nerves from which they spring, a ball of orris-root or a few drops of muriatic or acetic acid might be admitted into the trachea of a dog without uneasiness; whereas, while the nerves were entire, a drop of blood in the trachea induced cough, and the balls and acids most violent cough, which instantly ceased on the division of the nerve, and was succeeded by mucous rattle without expectoration, the mucus no longer exciting sensation, nor the muscles possessing power for its expulsion; and death ensued in less than an hour. (*Rech. Expér.* p 167.) As the recurrents supply the opening muscles of the glottis, the division of those nerves causes the death of young animals, since in them the rima glottidis is narrow; in the older, or in animals whose rima glottidis is of such a form that its sides cannot touch, dyspnœa and a croaking sound of the voice instantly follow from their approximation.*

* Dr. Le Gallois, *Expériences sur le Principe de la Vie.*

Some think that filaments go from the recurrents to the closing muscles also; but Dr. H. Ley conjectures, with probability, "that these, together with the anastomosing branches of the superior laryngeal and the recurrent, are intended for those rapid and delicate associated actions connected with the voice by which the chordæ vocales are rendered more or less tense, and their vibrating portions longer or shorter; whilst the main branches, described by Mr. Swan as termi-

produce blisters, fractured bones and soft parts unite, in limbs which are perfectly paralysed. But the involuntary functions are closely *connected* with the encephalon and spinal chord; for the *sudden* destruction of these parts, or of a certain extent of them, puts a stop to the circulation.[d] This, however,

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The pneumono-gastric next supply the membrane of the bronchiæ and air-cells, so that, after their division, an animal may be plunged into water without any uneasiness or effort at respiration, although previously violent struggles ensued; or the animal may be kept in confined air or nitrogen, and, although it still breathes and laboriously, it gradually dies, we are told, without any suffering. We breathe from an uneasy sensation; but, after the division of these nerves, the want is little felt. Respiration continues for a time, probably from some nervous connection; for, if the origin of the nerves in the chorda oblongata is destroyed, respiration ceases at once.* Dr. Brachet believes that all excitement of the heart by the brain, even though the cause be pain induced any where, is communicated by the pneumono-gastric; for excitement of the heart from causes of pain ceased on the division of these nerves, and did not occur if they were divided before their application; nor would irritation of the upper extremity of the divided nerve, or of the brain, excite the heart.

They give sensation, we have seen, and also, according to some, motion, to the stomach. According to Dr. Brachet, the stomach still acts but antiperistaltically, so that its muscular excitability does not depend upon the nerve, though it may be acted upon through the nerve. On irritating its œsophageal plexus, the œsophagus and stomach contract, and, after its division, their peristaltic action ceases.†

[d] Dr. Le Gallois, *Sur le Principe de la Vie*; and Dr. Wilson Philip, *Exper. Inquiry.* Probably by excessive stimulus, as the voluntary muscles are afterwards insensible to stimuli, although, after a mere division of their nerves, they retain their excitability.

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nating in the opening muscles of the glottis, are for the purpose of those grosser movements of the rima glottidis connected with respiration and deglutition."

* In considering the continuance of respiration after division of these nerves, and the occasional occurrence of rattling and apparently laborious breathing without any suffering for even a long time before the death of some persons, we must reflect how faint an uneasy sensation causes us almost unconsciously to will an action, — how we wink all day, and hem, without thinking of the sensations which excite our will, or thinking of the exertion of our will. A person may have sensation enough in the lungs to make him breathe, and yet not enough to make him suffer. When dogs plunged in water after the division are said to have made no effort to breathe, I presume that the faint sensation induced them to make a faint effort, but was not sufficient to induce them to contend for respiration, as they must have done, from the absence of air.

† Drs. Tiedemann and Gmelin, *Recherches sur la Digestion.* Drs. Breschet and Edwards, *Arch. Génér. de Médecine,* 1821.

is no more than happens if any important part of the body receives an injury, or if any unimportant part is extensively injured;—if a leg is crushed or falls into gangrene, the whole system suffers, though a leg may be removed and the system be none the worse.[e] The application of stimuli to the encephalon or spinal chord excites the action of the heart, and, even after its removal, of the capillaries: but stimulus to any important part will stimulate others; and even to an unimportant part, if the stimulus is strong. The passions do the same: but they influence all parts; and, though a due excitement of the passions is necessary to the health of all parts, it is only because the body thrives best as a whole when each part fully performs its functions. Compression of the brain causes slowness of the pulse and constipation; but this is only such a sympathetic influence as may exist between any parts. It appears, from Dr. Brachet's experiments, that irritation of the brain affects other parts by means of the pneumono-gastric; for its division prevented all effects of the brain upon the heart.[f]

The removal of a piece of the pneumono-gastric, or the destruction of that part of the chorda oblongata with which it is connected or of a considerable portion of the chorda spinalis, heavily impairs the functions of the lungs and of the stomach[g], putting a stop, some say to the muscular action of the stomach, others to the secretion of gastric juice and to digestion. The

[e] The hearts of six decapitated robbers beat strongly and regularly for nearly half an hour; and after a man's cerebrum and cerebellum were blown off by an explosion of fire-arms, the respiration and circulation continued above half an hour. (Dr. Brachet, l. c., p. 80. sq.)

[f] *Rech. Expér.* p. 118.

[g] Le Gallois, l. c., and many former writers.

Dr. Philip conceives this influence of the brain and spinal chord to be galvanic, as he prevented the ill effects of the removal of a piece of the pneumono-gastric nerve upon the lungs and stomach, by supplying these organs with galvanic influence. (l. c. p. 210. sqq.) Dr. Brachet, however, equally succeeded by mechanically irritating the end of the portion of the divided nerve running to the stomach.

Division of the nerve had no effect if the divided ends lay opposite each other, although a quarter of an inch intervened. (Dr. W. Philip, l. c. p. 226. sqq.)

A mechanical stimulus, or a substance in its nature stimulating, applied to the brain about the origin of the nerves, excites contractions in the voluntary muscles; a substance in its own nature stimulating excites the heart and capillaries, when applied to any part of the brain or spinal chord, but requires to be applied to a considerable portion. (Dr. Philip, l. c.)

animal may continue quietly to eat till the stomach is enormously distended; and this, no doubt, because the stomach is deprived of its sensibility so that its distension is no longer felt, and the animal, though it must at the same time be insensible to the pangs of hunger in it, continues to eat from habit or the pleasure of masticating.[h] We need not suppose its muscular power to be destroyed by the injury of the nervous system, because continued eating must produce over-distension, though the power of contraction be, before the over-distension, unimpaired. Dr. Philip maintains that the injury suppresses the secretion of gastric juice and digestion; but Drs. Leuret and Lassaigne assert that digestion proceeds as before, though even six inches of each nerve be removed in the horse; and Sir B. Brodie and Dr. Magendie found digestion uninfluenced, if the division was made, not in the neck, but close to the stomach; and, again, Dr. Magendie found digestion proceed in brutes after the removal of the cerebrum and cerebellum. (See *suprà*, p. 87.)

The division or ligature of the pneumono-gastric nerve has been a favourite experiment with endless vivisectors from the time of Galen himself; but I believe that Dr. Le Gallois was the first to point out that the blood experiences no longer the chemical changes in the lungs, but their air-cells become filled with frothy mucus, their substance gorged with blood, and their surface marked with dark patches. The engorgement and black patches result, however, merely from the want of changes in the blood; and this partly from the animal scarcely feeling the want of respiration; so that in a rabbit the respirations instantly become very slow, — an instance analogous to the slow breathing of sleep and the much slower of apoplexy, in which states the want of respiration is less perfectly felt; and partly from the stay of all the mucus in the air-cells and tubes, which, like the stomach, have lost their sensibility, so that, the quantity of mucus not being

[h] Dr. Le Gallois found that, after this division, a guinea-pig would eat, from habit or the pleasure of the mouth, till its belly was as long as its body; and the œsophagus would also become distended, sensation being lost and muscular power paralysed. Dr. Brachet kept animals without food, and they showed all the signs of hunger. He divided the pneumono-gastric, and then offered them food. But they were now indifferent to it; and, on being enticed to eat it, they ate on till the stomach would hold no more and the œsophagus was filled. The cessation of muscular action might be the result of merely the loss of sensibility.

felt, none is expectorated, and mucous rattle occurs in the trachea. The blood, consequently, is no longer exposed properly to the air. These changes are declared to happen even after death, if the experiment is made as soon as the animal is killed; but I really doubt this.

Every point of the body communicates with the brain by means of nerves: since, on the one hand, every point of the organisation either is sensible or may by disease acquire sensibility and communicate painful sensation to the brain[i]; and, on the other, mental emotions, continued or violent, may affect any point. We cannot, therefore, be surprised to see nerves pass between the encephalon or spinal chord and parts which ordinarily have no sensation and are never under the influence of volition. Indeed, many parts considered insensible are at all times destined to give some variety of sensation, under certain circumstances, without any morbid sensibility. The want of chemical change in the lungs for less than a minute so impedes the passage of blood through them, that we have an uneasy sensation: the stomach feels hunger, and it, and the intestines, and urinary bladder, feel distension every day in health: the ligaments, undoubtedly, give a peculiar sensation if a joint is over distended: and the testis or coats of the testis when compressed.[k] The functions of the lungs and stomach could not easily proceed without sensation. In the one we feel the want of air, if we interrupt the function, as we continually do when talking and eating and performing many other acts, in all which we are compelled to attend to respiration by an uneasy feeling: without sensation in the stomach, supplies of food would not be given to it and regulated. The necessity for almost continual sensation in the lungs and stomach explains why a nerve goes directly from the brain to these organs,—the pneumono-gastric. The end of the intestines and the bladder require habitual sensation for their functions, and they are well supplied from the spinal chord. The functions of the rest

[i] In nervous disturbance, the parts which carry on the organic functions without sensation sometimes acquire such sensibility that the ordinary silent processes appear attended with sensations: at any rate, unusual sensations are felt in such parts.

[k] I have compressed the tunica vaginalis and the albuginea when the testis was atrophied after mumps, and great pain was felt. Still, although nothing but membranes appeared left, there probably was a portion of the gland, as pressure of the vas deferens is equally painful.

of the intestinal tube, of the liver, kidneys, and absorbents, &c. of the abdomen require no sensation in health ; and sensation, therefore, occurs in them only under unhealthy influences, and they neither require nor have communication with the brain beyond such an amount as all parts possess for occasional sensation and the sympathetic influence of the mental affections of the brain, and that influence which it, like all other organs, exerts at all times on all parts. There is thus a sufficient reason for the presence of encephalo-spinal nerves where there is no volition, and where ordinarily no sensation occurs, without ascribing nutritive or functional influence to them.

Although the division of the spinal chord or of its nerves, or compression or disorganisation of these or of parts of the brain, prevents voluntary power over the corresponding muscles, without suspending the circulation, &c. in them, and does not impede the functions of the lungs or stomach; yet circulation, and, what are dependent upon it, — nutrition and frequently animal heat, — are evidently impaired. Sir Everard Home found that, by dividing the nerves running to the horn of a buck, the temperature of the horn fell about 6° below that of the other, and, as the divided ends advanced in the process of re-union, the temperature rose again towards a level.[l] Palsied limbs are often colder than others, or, as Dr. Abercrombie enounces the fact more accurately, are more easily cooled and heated, — follow variation of external temperature more, — than others. Palsied limbs waste, and the ends of the palsied fingers are very pale, and the nails blue from time to time, for want of use. Division of the trigeminum pair of nerves close to the brain causes inflammation of the eye and cloudiness of the cornea; and its division at its ganglion Gasseri produces opacity of the cornea and ulceration and destruction of the eye.[m] The attempt to cure morbid sensibility of the horse's foot by dividing its nerves has been relinquished on account of the frequent separation of the hoof after the operation. Injury of the lumbar spine frequently occasions alcaline urine. In hectic fever, sweat breaks forth generally as soon as the patient falls asleep, — as soon as the brain becomes inactive. Some persons have large quantities of acid rise into the mouth, and suffer other dyspeptic symptoms, if they fall asleep after dinner. It is indeed maintained that in paralytic parts the muscles only waste, and

[l] *Phil. Trans.* 1826.

[m] Dr. Magendie, *Journal de Physiologie,* t. iv.

their atrophy is ascribed to want of use. The loss of the hoof after division of the nerves is said by Mr. Youat to occur only when considerable inflammation is present at the time; that the horse, having no sensation in the part, knocks it about, and increases the inflammation to such a point, according to him, that the hoof is detached: he assures me that, if no severe inflammation is present at the time of the operation, the hoof is not lost.

Now, such among these effects of division or incapacitation in any way of parts of the nervous system as cannot be attributed to indirect circumstances, do not, in my opinion, militate against the numerous general facts already mentioned of the independence of the organic properties and functions upon the nervous system. I do not see that we are justified in considering these results as more than instances of the sympathetic influence of one part upon another. All parts influence each other and the whole system exclusively of their peculiar functions. The encephalo-spinal nervous system must be like all other parts in this respect: and yet every result of their injury on other parts is strangely regarded as a proof of dependency upon them. Besides its functional powers and influences, its condition, even as to its structure and organic functions, must sympathetically affect other parts, — a fact too often overlooked, and thus power has been presumed for it without reason. When the kidneys are in such a state that they produce sugar, a mental impulse is destroyed, and the power of the genitals is lost. Under diabetes a man usually has no sexual impulse and is impotent, yet no one supposes that the faculty of the brain known as sexual desire, or the vigour of the genitals, depends upon the kidneys. The brain is besides especially connected with every other part of the body, and is one of the most important organs which exist. The effect, therefore, which any injury of it must have over other parts must be very great. But children live and eat and preserve their temperature for many days, though born without brains; and we have seen what was borne by brutes in the experiments of Duverney and his imitators. Nay, we have seen that injury of nerves not supplying a part will injure it; just as the extremities may be absent or removed without injury to the functions at large, and yet diseased states or severe injuries of them may destroy the system. Injury of nerves, just as of any other organs in proportion to their importance, may affect parts, not which they supply, but with which they are connected:

amaurosis and even cataract may follow wounds of the nerves belonging, not to the eye, but to the face; and convulsions may follow wounds of the acoustic nerve. Although disease of the spine injures the renal secretion of urine and causes inflammatory excitement of the mucous membrane of the bladder, disease of the kidney frequently produces such an affection of the corresponding part of the spinal chord, and consequent paraplegia [n], that both are ascribable to sympathy only; for no person would consider the spinal chord as depending on the kidney for its power. Castration prevents the horns of the buck from coming, or from growing longer and being shed; and the removal of the boar's tusks destroys his violent sexual propensity [o]: yet these effects are not thought to show dependence, but merely connection.

Although the involuntary and unconscious functions do not appear to depend upon the encephalo-spinal system, an argument in favour of their dependence upon the ganglions and ganglionic nerves, properly so called, is the fact,—that the ganglionic system of nerves is formed before the encephalon and spinal chord; indeed, the nervous system of the chest and abdomen are fully formed, while the brain appears still a pulpy mass. [p] These ganglia and nerves, it may be urged, would hardly be formed before the encephalon and spinal chord but for the sake of the organs which they supply, and the functions of which (with the exception of the genitals) are as perfect at birth as at adult age; while the brain and its mental powers are slowly perfected. Although the encephalon and spinal chord may be absent in monsters [q], the ganglionic system is, perhaps, always perfect, unless in extreme deviation, where the nervous system may be diffused invisibly, as in some lower animals. But I do not know

[n] See a paper by Mr. Stanly, full of interesting facts, in the *Med. Chir. Trans.* vol. xviii.

[o] Lisle *On Husbandry*, quoted by the Rev. Gilb. White, *Nat. Hist. and Antiq. of Selborne*, 1837. p. 304. sq.

[p] Gall, l. c. 8vo. t. i. p. 191. See also 4to. vol. iii. p. 239. sq.

[q] Lobstein, p. 52. sqq. *De Nervo Sympathetico*, 1823, relates six cases of absent brain and other organs, where the ganglionic system was perfect or even remarkably large; and Dr. Cayre relates the dissection of nine idiots, in whom the encephalo-spinal system was diseased and wasted, the ganglionic healthy. *Nouveau Journ. de Méd.* t. iv. In Gall's 4to edit. vol. i. p. 37. sqq. will be found a history of the hypotheses respecting the use of the ganglia, as well as in Lobstein's more recent work.

that it has ever been absent. The heart never exists without its ganglion; so that the cardiac ganglion, as the heart is the first organ that comes into action, is the commencement of the nervous system.

A striking difference is observed in the structure of ganglionic nerves and the effect of injuries upon them. Bichat asks, "What anatomist has not been struck with the difference between the cerebral and ganglionic nerves? Those of the brain are larger, more numerous, whiter, denser, subject to fewer variations. On the other hand, extreme tenuity, considerable number, especially at the plexuses, a grey colour, remarkable softness, and very frequent varieties, are the characters of the ganglionic nerves, if you except those which communicate with the cerebral, and some of those which unite" the ganglia.[r]

If these nerves are cut, or their ganglia torn, some assert that no pain is produced. Dr. Brachet declares that he found the spinal nerves running to the sympathetic ganglia to be very sensible: the nerves running from and between ganglia to be insensible, unless inflamed, and, when inflamed, to become sensible, but at the inflamed point only, and to lose their sensibility again if the twigs of communication with the spine were divided: a ganglion to be sensible or insensible accordingly as a point in it was touched or not in which a spinal nerve ran, and to lose all sensibility on the division of the nerve connecting it with the spine; to be very sensible if inflamed, but insensible again on the division of the spinal nerve.[s] If all the ganglia of the neck are removed, and even the first thoracic, Dr. Magendie says that no sensible or immediate derangement of the functions is observable, even in parts to which the filaments united with them may be traced.[t] Bichat long since remarked no disturbance of the heart's motion on attempting to irritate, or on dividing, the cardiac filaments of the sympathetic; nor of the stomach, bladder, &c. by applying violence or stimuli to their ganglionic nerves. Neither did he succeed with galvanism[u]: but Humboldt and Dr. Fowler, Home and

[r] *Recherches Physiologiques*, p. 72. sq. 1805. See also *Anat. Générale*, t. i. p. 222.

See also Gall, l. c. 4to. vol. i. p. 40. sqq., 8vo. t. vi. p. 312.

Dr. Magendie, *Précis Elément.* t. i. p. 171. sq.

[s] l. c. p. 304. sqq.

[t] Dr. Magendie, l. c., says he has made these experiments repeatedly.

[u] l. c. 334. sqq., 360. sqq.

Weinhold, say that they succeeded with galvanism in the case of the heart[x]; and Dr. Bartels declares that, when he opened the chest of six robbers in 1826, immediately after decapitation near Marbourg, he found the heart beat regularly for half an hour, and, when languishing, to be momentarily excited by irritating the great sympathetic, though irritation of the spinal chord had no effect on it, but on the muscles of the trunk.[y] Dr. Brachet asserts that, on dividing the cardiac plexus, the action of the heart instantly ceased for ever; probably, however, from the shock, since the hearts of brutes taken out of the body will beat.

But let us examine this hypothesis a little farther. Besides the mental faculties of the encephalon, and the transmission of the will from it, and of impressions for sensation to it, by the spinal chord and the nerves of motion and of sense, two other kinds of phenomena remain, one of which possibly, and the other certainly, depends upon the nervous system. The former is the excitability, irritability, vitality, life, or whatever else it is termed, possessed by every part: the other is the various degrees and kinds of sympathy which exist among the different parts of the system, and the influence of the mental feelings upon the body at large, the susceptibility of which influence is but that of sympathy with the encephalon. Now the ganglions and ganglionic nerves must have some function, and, as they are not the organs of the mind, nor concerned in sensation, or volition, the only functions which remain are the supply of excitability, the transmission of sympathy, and the effects of mental emotions, and the affording a passage to encephalo-spinal filaments of sensation to those parts which do not otherwise receive any; for every part is capable of sensation in inflammation, and therefore must always have nerves connecting it with the brain, however indirectly. The rise and progress of the opinion which gives them the first office are detailed by Dr. Fletcher, who advocates it strongly, and, in addition to the fact of the earlier development of the ganglionic than of the encephalo-spinal system, urges the following arguments.[z]—It is more strongly developed in children and females than in the less irritable adult and male. They appear universally distributed. The arteries of the brain and all the

[x] Dr. Le Gallois, *Expériences sur la Vie*. Dr. Brachet, l. c. p. 127.

[y] Dr. Hufeland's *Journal*, quoted by Dr. Brachet.

[z] See Dr. Fletcher's *Rudiments of Physiology*. Edinb. 1836. P. ii. a. p. 64. sqq.

larger blood-vessels are supplied by them, and these may convey them throughout the frame. There is no reason to say that the ganglionic nerves merely arise from the encephalo-spinal: they give branches evidently to the encephalo-spinal[a], and consequently we may presume that they are as extensively distributed; and the ganglionic nerves are very fine and at length must be invisible. The property they give must be supposed similar to that of sensibility: and we see, therefore, why they have ganglia exactly like those of nerves of sensation, inasmuch as they consist of grey and white substance inextricably mixed, and their white matter is exceedingly soft like those nerves, whereas in nerves of motion it is hard; and we are not surprised to find them convey galvanism badly, like nerves of sense, while nerves of volition conduct it well; nor to find that, as narcotics applied to nerves of sensation destroy the sensibility of the parts which these supply, so, when applied to ganglionic nerves, narcotics destroy the excitability of the parts supplied by them. The filaments of ganglia are declared by Lobstein[b] to be different according to the organs which they supply, just as we know the vital properties or excitability of every organ to differ. Hence we cannot wonder at the continuance of the organic functions during inactive states of the encephalo-spinal system,—in sleep and coma; nor even when the brain is removed, or the muscle itself is detached from the body: we cannot wonder at the division of the principal trunks belonging to a muscle not preventing its irritability from being renewed after exhausting stimulation has been intermitted. Lastly, when the encephalon, or both it and the spinal chord, are wanting in monsters, the ganglionic system almost always, if not always, exists; and is said never to be absent, if a monster is not far

[a] This is shown by Mr. Mayo, l. c. p. 265.; and Mr. Swan conceives that there is no doubt of the branches of the sympathetic proceeding to the sixth, instead of arising from it. (*On the Nerves.*) But, above a century ago, Petit demonstrated the error of those who derived the sympathetic from the fifth and sixth pairs (*Mém. de l'Acad. Roy. des Sc.* 1727); and Fontana, according to Girardi, argued against the origin of the sympathetic from the third or fifth pair, because the twigs were not detached from these pairs, but ran to them; so that they should be called the end and not the origin of the sympathetic. Professor Panizza declares that the branches of the sympathetic which ascend with the carotid artery merely entwine around the sixth pair, and may be detached without injury to their continuity. (*Ricerche Sperimentali,* p. 6.)

[b] *De Nervo Sympathetico.* 1835.

removed from the human form: and in idiots, with a want of quantity and quality of encephalo-spinal substance, the ganglionic system is usually well developed and sound. No wonder, therefore, that, by irritating these nerves, the parts to which they run are not pained or moved; for they are not nerves of sense or motion, but, instead of stimulating, give the property of being capable of stimulation. Again, the division of the ganglionic nerves is not followed by a loss of excitability, as the nerves in the parts themselves appear calculated to produce excitability, since the ganglionic nerves contain, like their ganglia, grey and white substance, not white substance only, like the nerves of sensation and the nerves of motion, both which are merely transmitters, and not producers, of the respective qualities with which they are concerned.

A powerful argument against this hypothesis is the circumstance of no nerves existing in vegetables, although they are nourished and secrete great varieties of substances, — perform organic functions similar to those of animals. Another is the account of fœtuses having existed without nerves; imperfect fœtuses indeed, but still animal organised active substances.[c] Another is the circumstance of a clot of blood becoming organised before it is connected with surrounding nerves or vessels. Another is the fact that, while some parts are abundantly supplied with ganglia and their nerves, other parts of great size, of great vital properties, of great secretion, have no more supply than is communicated along all arteries, and which is very far short of what parts supplied with ganglia and plexuses must possess. I allude to the extremities, in which are a great extent of superficial and cellular secreting structure, as well as the synovial membranes of the joints, great masses of muscle, &c. that would require ganglia for their nourishment and powers as much as the stomach, liver, and other viscera; and yet they have no ganglia and receive no more ganglionic nerves than what pass insensibly along the arterial coats, while the viscera have copious supplies to their blood-vessels, amidst which numerous plexuses and ganglia are found. The various experiments made to prove the importance of nerves to secretion are considered unsatisfactory by Dr. Brachet — a great supporter of the necessity of the nerves to all the organic functions; and his own appear to me equally unsatisfactory. Finding that he could

[c] Dr. John Clark, *Phil. Trans.* 1775.

not prevent the secretion of urine by dividing all the nerves of the kidney, he divided the renal artery, and passed a canula between the two portions, so that no nerves could run to the organ along the arterial coats. Secretion ceased. But the functions of the small vessels were unlikely to continue when the trunk was so severely injured: just as we shall find the functions of the ovaria or of the testis often to be arrested by dividing the Fallopian tube or vas deferens. For what purpose of nutrition or supply of properties can a ganglion be particularly required just in the situation of the ophthalmic or the otic? But, if we reflect that the motions of the iris and muscles of the internal ear must be regulated by the condition of certain other parts, we can understand why those ganglia exist in their respective places. For the ganglionic system, no doubt, communicates important influences. The functions of each of the complicated and numerous organs of all but the lowest animals, require constantly to vary according to the condition of others. Not only, for instance, does every organ of digestion, assimilation, and excretion, require to be in nice adjustment with another and with all, but is each affected by organs not forming a part of the group nor necessary to their powers. The nutritive functions do not require the brain; yet if the brain is harassed by a disagreeable state of feeling — sorrow, vexation, anxiety, &c. — whatever be its intensity, that group suffers, and dyspepsia, diarrhœa or costiveness, pale or morbidly coloured stools, a morbid colour of the urine and the skin, in some degree or other result. Whereas, in a happier state of mind, the functions, cæteris paribus, go on well; and, in a truly happy state, persons are often struck with the excellence of their condition. *The converse operation of all these upon the brain is as certain.* Now, if such is the mutual influence of organs not necessary, except indirectly, to each other, but bound up, where they all exist, into a common whole, so that the well-being of each is essential to the well-being of the whole, we may well conceive the important influence of organs upon each other which co-operate in function. I conceive the influence of organs upon each other to be incessant, and to be ever varying accordingly as the state of each influencing organ varies: and that they are all at all times influenced and influencing. This constant mutual influence is indispensable to perfect function, though it frequently disturbs function: and, as all seem thus bound together into a common whole, the removal of this general and particular influ-

ence by the division of the nerves of an organ must affect it; and the more readily shall we believe this, when we consider that the nerves are so minutely and universally distributed throughout each organ. But the dependence of all parts for their vital properties upon nerves is a very different matter, and appears to me far from having been proved or even rendered probable. If the vitality or irritability, &c. of all parts is given by the nerves, what gives it to the nerves? If one mass of matter can become by combination and organisation and suitable circumstances endowed directly with it, why cannot another? To suppose nerves indispensable to vitality is to ascribe to nature circuitous and complicated means when unnecessary. The action of voluntary nerves is merely to excite the irritable muscular fibre; the operation of nerves of sensation is not to endow the constituent parts of organs with sensibility, but to be present in the organs, and with their sensibility feel impressions made upon them. But this hypothesis does not make the nerves excite, as in the former case, nor be the residence of the peculiar properties of the part, as in the latter. It makes the nerves give powers of contraction, secretion, &c. none of which they themselves possess. When persons suppose vitality to be given by nerves, they do not suppose the nerves to be the organ, but to communicate to the constituent parts properties which they themselves or their system have engendered, and which properties they themselves do not possess, except that they have vitality in common with all parts. If all organs were nerves, I could understand how nerves might be declared necessary to all parts for their vitality: but, as nerves are not supposed to perform the functions of the organ, I cannot see why the organ should not by its composition and organisation be sufficient, without another composition and organisation to give it the powers it possesses: and besides, there are the facts respecting vegetables, nerveless fœtuses, and clots of blood, already mentioned, which show that vital properties may exist without nerves. The various specific properties of the various parts of the system are totally different from those of the encephalon, spinal chord, ganglia, and nerves, and must depend upon the specific composition and organisation of each part, or each part would not require and have a specific composition and organisation. If a part runs to another and pervades this, as in the case of the nerves of sensation, that part, having its own properties wheresoever it goes, will have them in the part

which it pervades; but it cannot give them to this, and far less can I believe that it gives to this properties which it itself does not possess: and, as to its performing the offices of the part which it pervades, the thought is not entertained; and yet, except by admitting such an absurdity, I cannot see how the power of secretion, nutrition, &c. can be ascribed to nerves. The hypothesis is usually confined to the ganglionic system: and the encephalon, spinal chord, and encephalo-spinal nerves are considered to be appropriated to the intellectual and moral functions, sensation, volition, and the mutual influence of the brain and rest of the body. That the ganglia and ganglionic nerves are developed in proportion to the activity and force of the circulation, and to the development and activity of the functions of organs, is no more an argument for the dependence of the vital properties of these upon them, than the simultaneous development of the ganglia and of the various viscera in early life. The sooner the viscera are formed, the sooner must the ganglia and nerves which convey influence to and from each of them be also formed; and, the more bulky and active an organ, the more nerves will it require to influence and be influenced by other organs. All must allow that the ganglia and ganglionic nerves cannot be for the purpose of vitality alone, since branches from both anterior and posterior encephalo-spinal nerves join them and form part of them.

I should consider the functions of all nerves to be analogous to each other. The spinal chord and encephalo-spinal nerves do not give properties; they communicate only between the brain and the rest of the body. They convey to the brain an impression of the state in the form of sensation; and they convey an influence from the brain in the way of emotion or volition. They do not bestow the qualities of the brain, much less convey qualities which it has not. They convey volition, and the influences of the moral feelings, from the brain, and carry back the impressions of sensation to the brain. Analogy would incline us to suppose that nerves running between other parts would convey to those parts, in either direction, the impressions of the state of the communicating parts, —this impression, like the impressions of sensation when followed by volition, being sometimes followed by an influence to some third organ or some other portion of the first organ.

Dr. Brachet concludes from his experiments that the encephalic nerve, called pneumono-gastric, gives moving power to the air-

cells of the lungs, the stomach, and the upper part of the small intestines: and that the motion of the lower part of the small intestines, of the large intestines, the bladder, and uterus, is dependent upon the spinal chord. That the action of the bladder and the lower part of the large intestine depends upon the spinal chord cannot be doubted; because the functions of the bladder and rectum are carried on with sensation and volition. If these parts are paralysed, the rest of the large intestines and the adjoining portion of the small will suffer accumulation, from which he drew his inference, though they themselves be not paralysed. The regular contraction of the stomach ceased indeed after the division of the pneumono-gastric; but the stomach was not paralysed, for it acted antiperistaltically after the division. This he ascribes to irritation of the divided end of the nerve. But such an irritation ought as readily to have excited the regular contraction of the stomach. Dr. Wilson Philip denies that the division paralyses the muscular coat of the stomach; and Drs. Leuret and Lassaigne say the paralysis is confined to the cardia. If Dr. Brachet is right in his fact, still some might say it was through the division of the ganglionic nerves united with the pneumono-gastric that the paralysis was occasioned. The instant cessation of the motion of the heart on the removal of the cardiac ganglion may be ascribed, I have already said, to the shock as probably as to the absence of the ganglion.[d]

[d] I will not presume to doubt Dr. Brachet's fidelity, but his results all square so wonderfully, except where he is not aware they do not, that confirmation would be desirable, were it not for the torture necessary. Some points, however, in his experiments I do not comprehend. In one experiment (lxxxiv.) we saw that, after the division of the pneumono-gastric, a puppy might have its head plunged in water without making any effort to raise it and to breathe; yet in other instances (xl. and xli.) puppies made violent efforts to inspire. He does not explain the difference, but explains the efforts to breathe on the score of habit. The explanation I attempted of the difference (*suprà*, p. 434.) may not be satisfactory to all. When wishing to show that the secretion and discharge of semen are independent of the encephalo-spinal nerves, he mentions the case of a man completely paraplegic, and as high as all the lower fourth of the abdomen, without any sensibility of the external parts, or the interior of the rectum or urethra: and yet the man had two children in the time. How the necessary movements were performed, without voluntary power of the lower parts, and how ejaculation could occur without sensation of the external parts or urethra, I cannot imagine. He reduced poor tom cat to the same situation by dividing the spine in the lumbar region. Here he allow hat the necessary movements were impossible. However, he sup-

When I consider that every part must have nerves for feeling, because every part may become sensible — capable of experiencing

plied their place by " une sorte de masturbation," which was neither more nor less, I suppose, than *la masturbation.* It required more time, he says, but at length he made the cat emit. This was what some bluff John Bulls would call French taste. Now, as the cat had lost all sensation, I cannot see how it could be alive to the pleasures of masturbation, — how emission, which in coition results only when sensation arrives at a certain height, could be excited; nor how the presence of semen in the urethra could be felt and ejaculation effected. Whatever might have been the effect of imagination on the man, the cat must have been a stranger to the pleasures of imagination as much as of Dr. Brachet's masturbation. Dr. Brachet, on the other hand, seemed delighted; for, as if he had not proved what he wished, he masturbated the cat again the next day (je fis répéter la même manœuvre (literally), et une nouvelle éjaculation eut lieu); and, not yet satisfied, he did it again the day after. There, I am thankful to say, he stopped. " Je m'en tins là, et l'animal me servit pour d'autres expériences." Not only were these repetitions superfluous, but the experiment was altogether superfluous, as the man's case was perfectly similar. I do not think a physiologist would have ventured to divulge such a disgusting experiment in this country; and I cannot refrain from expressing my horror at the amount of torture which Dr. Brachet inflicted upon so many unoffending brutes. Nearly or quite two hundred must have suffered under his hands. I hardly think that knowledge is worth having at such a purchase; or that it was ordained that we should obtain knowledge by cruelty. I care nothing for killing a brute outright, without pain: it is then but as before it was born, feels no loss, and escapes all further chance of suffering. Vivisection may be justifiable in some instances. But before an inquirer commences an experiment of torture, he ought to be satisfied of its absolute necessity, — that the investigation is important and the means indispensable; and also that he is master of the existing knowledge on the subject, and qualified to operate and to philosophise upon the results. He should proceed to the task with the deepest feelings of regret. I do not wish to make a parade of feeling: but to torture animals unnecessarily is a most cowardly and cold-blooded act, and in my opinion one of the utmost depravity and sin. A course of experimental physiology, in which brutes are agonised to exhibit facts already established, is a disgrace to the country which permits it. My esteemed French friends will pardon me, but I fear that in France there is among many too little repugnance to vivisection *: and I am sure that the following experiment would have caused Dr. Brachet to be blackballed in any respectable

* In his youthful days the tone of feeling among French medical students must have been bad, unless the following brutality was followed by immediate expulsion from the hospital. He says that one of his colleagues, when he was interne of the Hôtel Dieu, regaled the rest of them with a dinner of cats, *which he had experimented upon in their lifetime;* and the next day sent the skins, bowels, &c. to the party in order to let them know what they had eaten. (p. 338.)

impressions and transmitting them for sensation to the brain, and must have nerves for incessantly influencing and being influenced by the rest of the frame, and in many instances for influencing or being influenced by some other organ in particular, the existence and the amount of nerves called the ganglionic system, in addition to those which convey volition and possess sensibility, is explicable; and I conceive it unnecessary to invent any other use of them. These purposes of the ganglionic nerves are certain. To ascribe others is an hypothesis; and in my opinion a very improbable and inconsistent hypothesis. The old name of sympathetic system appears to me highly proper, because it expresses the use of the system, as far as is known to us. The especial use of ganglia is unknown. If Gall's opinion of the use of the pulpy substance is right, and I think it is, they, as they contain pulpy substance, may be, like ganglia in the brain and chord, destined for the origin and reinforcement of the nerves, as well as for their mingling. The encephalo-spinal nerves originate in pulpy substance; and the ganglia of the spinal nerves of sensation are probably to give them the greater bulk and num-

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society in England, for a physiologist was blackballed at the Royal Society from the horror excited by an account read just before of experiments in which rabbits' heads were crushed, though, on reflection, it was found that these experiments were unattended with pain, and he was honourably elected on an early occasion.—Expt. clxi. "I inspired," says Dr. Brachet, "a dog with the greatest aversion for me by plaguing and inflicting some pain or other upon it, as often as I saw it. When this feeling was carried to its height, so that the animal became furious as soon as it saw or heard me, I put out its eyes: I could then appear before it, without its manifesting any aversion. I spoke, and immediately its barkings and furious movements proved the passion which animated it. I destroyed the drum of its ears, and disorganised the internal ear as much as I could: when an intense inflammation which was excited had rendered him deaf, I filled up its ears with wax. He could no longer hear at all. Then I went to its side, spoke aloud, and even caressed it, without its falling into a rage,—it seemed even sensible to my caresses." Nay, Dr. Brachet repeated the same experiment on another dog, and begs to assure us that the result was the same. And what was all this to prove? Simply, that if one brute has an aversion to another, it does not feel or show that aversion when it has no means of knowing that the other brute is present. If he had stood near the dog on the other side of a wall, he might equally have proved what common sense required not to be proved. After all, I do not understand how it happened that the poor dog did not scent him. I blush for human nature at detailing this experiment; and shall finish by informing my readers that the Memoir containing this, and all the other horrors, obtained the physiological prize from the French Institute in 1826.

bers which they have above those of motion. The ganglionic nerves establish a communication between all parts without particular reference to the encephalo-spinal mass, and therefore do not originate in it: they would seem to require origin in pulpy substance somewhere, and therefore I should have imagined *à priori* that masses of pulpy substance would exist here and there for the origin and reinforcement of the nerves of general organic communication. Of course the ganglia must contain fibrous matter also; and, while they may serve for origin, or reinforcement, they appear to serve for mingling the filaments which enter and leave them. It is also possible that the ganglia are analogous to the encephalon and spinal chord, — that they act like certain portions of the encephalon and spinal chord in this, that, as soon as an impression is conveyed to them from one part, they may send forth an influence; just as, in the case of the encephalo-spinal mass, a sensation is felt and a muscular action may ensue.

We see encephalo-spinal nerves run to these ganglia, and some run in great abundance to parts not voluntary. They apparently mingle in ganglia with all the other filaments in the ganglia, as much as these do together; but they are not imagined to convey life, or the power of nutrition, secretion, &c. Why then should the others? They appear, like those which do not run to the ganglia, to convey impressions of sensation to the brain and of emotion or will from it: as well as such mutual influence as exists among all parts. Both the posterior and anterior root of the spinal nerves run to the ganglia of the sympathetic, as Scarpa showed above fifty years ago [e], and Sömmerring [f], whose remarks are now confirmed by Panizza.[g]

When sensibility is constantly wanted, as in the case of the lungs and stomach, and of the pelvic intestinal and urinary organs, a large supply of encephalic or spinal nerves is seen, and is given directly, without the intervention of ganglia:—the pneumono-gastric nerves, besides forming abundant communications with ganglionic nerves, run directly to the lungs and stomach, and certain sacral nerves to the rectum and pelvic urinary organs. The evident purpose of the encephalo-spinal nerves which run to ganglia being to convey impressions in both directions, I shall not

[e] *Anat. Annot.* lib. 1. § xi. p. 18.
[f] *De c. h. fabrica*, t. iv. § clviii.
[g] *Recerche Sperimentale*. Pavia, 1834. &c.

ascribe other purposes to them any more than to those nerves of the same class that do not run to ganglia. They take this course probably for convenience and complete mingling; just as the spinal nerves of sense and motion run together in one trunk, and these mingle by means of plexuses.

I may remark that it is even requisite not only for different organs but for different structures in the same organ to sympathise: a stimulus applied to the inner surface of the alimentary canal, heart, or urinary bladder, causes the muscular fibres to contract.

This mutual influence is *sympathy;* and it exists universally throughout the system, although the more palpable and striking instances of it only pass usually under that name.

We will now consider sympathy more minutely.

By sympathy[h] is meant the affection of one part of the body directly by the affection of another, through vital agency alone, independently of physical. When the sun shines into our eyes, or something irritates the nostrils, the expiratory muscles contract violently and we sneeze by sympathy. If the fauces are tickled, we vomit by sympathy. If cold is suddenly applied to the surface, the bladder endeavours to expel its contents by sympathy. This property of sympathising is indispensable to the functions of the body. Unless the operation of one part is varied according to the condition of another, the harmony of our functions would be destroyed. When the uterus has been gravid its full time, the breasts secrete milk: perhaps before this period, or whenever it may expel its burden. The presence of food in the mouth produces a flow of saliva from all the salivary ducts; and when semen touches the inner surface of the urethra the levatores ani and ejaculatores seminis are thrown into convulsions. When the skin perspires but little, the kidneys secrete more urine. The extreme importance of sympathy will appear when we consider that it occurs not only between different organs, but different parts of the same organ. The blood, the chyme, the fæces, are not applied to the muscular portions of the vascular and alimentary systems, but to their lining membrane;

[h] "J. H. Rahn, *De causis physicis Sympathiæ,* Exerc. i.—vii. Tigur. from 1786. 4to. *Sylloge select. eorum opuscul. de mirabili sympathia quæ partes inter diversas c. h. intercedit.* Edited by J. C. Tr. Schlegel, Lips. 1787. 8vo."

yet the irritation of this, independently of distension, excites the action of the muscular tissue. In disease these sympathies are sometimes more striking; because there may be an undue excitement of the part influencing, or undue excitability of the part influenced. An exquisitely sensible growth at the end of the rectum may produce tenesmus of the expelling muscles. On the other hand, in morbid excitability of the intestines, although the stomach be perfectly healthy, the ingurgitation of warm fluid into it will often cause immediate defecation; in neuralgia, at a distance from the stomach, oppositely, I have seen an instant aggravation of pain when any thing was swallowed; and I have attended two cases of violent cough in young men from the slightest touch of one half of the chest [i], though this was not in the least tender; indeed we have the skin exquisitely tender in some cases of hysteria, and when it is inflamed, without such effect. Sometimes natural sympathy may languish from the want of excitement in the influencing part or of excitability in the influenced. The iris will not contract by light if the retina becomes insensible; and, on the other hand, if the nerves of the iris are paralysed, the stimulation of the retina by light will fail to excite the iris to contraction.

Sympathies occur in disease between parts which are not observed to sympathise at all in health; and the disease may be in the affecting or affected part. When the liver is inflamed, the right shoulder often aches; when the hip joint is diseased, the knee is often the seat of severe pain: on the other hand, pain in an extremity often increases the very instant that stimulating articles are swallowed which in health scarcely caused a glow even in the stomach, and which still do no more than this in the stomach while they aggravate the pain. In disease new sympathies occur between parts which naturally sympathise, as when constipation of the intestines produces vomiting; and the breasts

[i] I presume that, as the sensibility of both halves of the surface was the same, the reason of such effects from touching the one only was, that the morbid excitability existed in that half only of the expiratory part of the spinal chord with which the nerves of sensation of that side were connected, and with which the expiratory portion of the other side sympathised. In hydrophobia, a slight blast of air, or the settling of a fly upon the surface, causes the inspiratory muscles to act suddenly and violently, though the skin is not tender to the touch. Yet I will not adduce this to illustrate the second cause of morbid sympathy, because a strong flash of light has the same effect; and light, noise, and the application of cold to the surface, or any slight and sudden cause of sensation, are very unpleasant, and show a morbid sensibility of all the external senses.

may become painful, and even secrete milk, when the uterus or the ovaria are only diseased.

The influence of mental emotions is an example of sympathy. The affection of the nutritive functions of the brain — such affections as are common to it and all other organs — the state of its circulation, the degree of its general excitement and of its strength, the state of its structure, all may sympathetically influence other parts, and may be influenced sympathetically in turn. But, besides these, the condition of the peculiar functions of certain parts of the brain exercises very powerful influence upon every part of the body. When grief, fear, anxiety, despair, terror, or contentment, hope, enthusiasm, joy, love or hatred, sexual passion, &c. &c. — occur in the brain, certain sympathetic effects take place in certain other parts of the body, as in the circulating organs at large, in the genitals, &c.; and the effect may be violent, even to destruction of life and perhaps laceration of structure, or continued so as, if agreeable, to remove disease, or, if unpleasant, to occasion functional or structural derangement in any part that may be the most predisposed. Now blushing under anger or shame, paleness, polyuria, and diarrhœa, under fear, erections under desire, all called effects of the passions, can be but so many changes occurring sympathetically from certain states of certain parts of the brain, as peculiar states of other functions of other organs affect different organs sympathetically.

It must be obvious that the sympathising part is not always that which appears to sympathise. When a voluntary muscle contracts sympathetically, it is not the muscle but the nerves moving the muscles, and indeed generally the ultimate fibres in the encephalon or chord, that are sympathetically excited; and the contraction of the muscle is the result of their excitement, just as it would be if their excitement occurred in any other way. The sympathy is not between the excited part and the muscles, but between it and the nerves of the muscles: wherefore, if the nerves of the muscle are divided, the sympathy still exists, but ceases to be manifest, because the muscles are no longer influenced by the sympathising nerves. Hence Bichat [k], — who divided sympathy

[k] *Anatomie Générale*, t. i. p. 183. sq.

John Hunter divides sympathy into general and partial; such as pyrexia from a wound, and vomiting from irritation of the fauces. Partial sympathy he subdivides into remote, contiguous, and continuous, — Where there is no evident connection between the sympathising parts sufficient to account for the circum-

as it affects animal contractility or sensibility, tetanus from a wound in the extremities being an instance of the former and pain of the knee in hip disease an instance of the latter; and as it affects organic contractility or sensibility, of which palpitation from disorder of the stomach is an example,— states that sympathy of animal contractility occurs only when the nerves connecting the affected muscles with the encephalon or spinal chord are entire. When he divided them, the convulsions in the corresponding muscles ceased: and the iris ceases to contract when the third pair is divided, though light glares on the retina.

Neither, where sympathetic muscular action arises from a sensation, will it occur, if the nerves communicating impressions from the affected part to the sensible part of the nervous centre are compressed or divided, or if the brain itself is unable to receive the impression. If the optic nerve is divided, the sun's rays will not excite contraction of the iris. Although the stomach in an animal newly dead may be thrown into contraction by mechanical irritation, no sympathetic action of the diaphragm and abdominal muscles,— no vomiting, occurs [l]; in perfect coma neither sneezing nor contraction of the iris can be induced by applying stimulants to the nostrils or letting the sun's rays into the eye.

The sympathies of the organic functions are not all ascribable, as many might imagine, to continuity of surface; for, after dividing the œsophagus of a dog, Bichat produced vomiting equally as before, on irritating the fauces [m], and Dr. Brachet sneezing on irritating the nasal membrane after having divided the trachea.[n]

Sympathy depends on the peculiarity of the impression as well as upon the part. "When the sides or soles of the feet are tickled," says Dr. Whytt, "the body is often thrown into convulsive motions; but nothing of this kind happens when those parts are either inflamed or wounded: neither an acrid injection of a solution of corrosive sublimate, nor the introduction of a catheter into the urethra, occasions any alternate convulsive motions of the

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stance; as vomiting from the pregnant state: — Where there is proximity of the sympathising parts; as tenesmus when a stone exists in the urinary bladder: — and Where, as most commonly, the sympathising parts are continuous; as itching of the nose and verge of the anus from worms in the intestine. *Treatise on the Blood, &c.* Introduction.

[l] Dr. Whytt, *On the Vital and Involuntary Motions.*

[m] *Anat. Générale,* t. i. p. 192.

[n] l. c. p. 298.

acceleratores urinæ, although the semen, which stimulates the nerves of the urethra much more gently, has this effect."

The same cause, too, may produce the same sympathetic effect, though applied to different parts. Convulsions arise from tickling any part of the skin capable of the sensation of tickling; nausea from a disgusting smell, taste, or sight: for the sympathetic effect results from the peculiarity of the impressions in the nervous centre.

The same sympathetic effect, lastly, may arise from many different causes in different parts: vomiting may arise from injuries of the head, a stone in the kidney, pregnancy, disgust, sailing, &c.[o]

Now, although it is evident that nerves are necessary to sympathetic contractions of muscles which are never moved but by the stimulus of nerves, viz. the voluntary, because it is the roots of these nerves in the brain or chord that sympathise, and the chords convey the sympathetic excitement; and that nerves are necessary to convey those impressions which occur in any parts and must be transmitted to the encephalon or spinal chord in order that the roots of nerves in these may be excited to stimulate the voluntary muscles ultimately affected; and although we must conceive that the influence of the passions must be transmitted to the various sympathising parts by means of nerves: still some deny that other examples of sympathy arise from nervous connection, because it frequently happens that no particular nervous communications of sympathising parts are discoverable, as between the nose or eye and diaphragm, although sneezing follows from a pinch of snuff in the nose or the sun's glare upon the eyes, while remarkable connections exist between other parts not particularly disposed to sympathise.[p] Vegetables, it is urged, which are not known to have nerves, show what has been termed sympathy: if a leaflet of the sensitive plant is stimulated by a burning-glass the whole leaf contracts and the foot-stalk drops; when the branches of trees feel the warmth of summer, the sap ascends from the roots, and even in a frost it will ascend from the roots through the stem, if a single branch is introduced into a hothouse.[q] But the former phenomenon is probably the result

[o] See Dr. Alison, l. c.

[p] Consult Dr. Whytt, *Observations on Nervous Diseases*, ch. i.

[q] Sir Gilbert Blane, *Medical Logic*, 3d edit. p. 154. In the *Times* for

of mere continuity of surface, which sort of extension of effect occurs in animals; and the sap is thought to rise from the roots in consequence of the mere expansion of the branches: but all true sympathy is no doubt effected by nerves, though mere nervous connection without peculiar disposition, or property, will not explain it.

The smaller number of organs and the continuity of most parts of vegetables produce sufficient connection of all spots without the necessity for distinct intervening bodies like nerves, which are absolutely required to connect the numerous, separate, and frequently quite uncontinuous and very distinct, organs of complicated animals.

Although the sympathies of animal systems, not explicable by continuity of surface, but true sympathies, must, I conceive, depend upon *nervous* communication, even where the sympathising part is not naturally stimulated by volition nor known to be stimulated to its functions by any thing but its contents, and although nervous communication can always be shown; still the intervention

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October 23. 1834, when I read it daily, was an account from the Berlin State Gazette, of a branch of a vine introduced into a hothouse, bearing flowers and fruit when the rest had none. Some, as M. Dutrochet, have imagined vegetables to have a nervous system, but never shown it. Dr. Brachet has lately contended for it, but the best botanists consider that this part of his book should not have been printed. The opinion has been thought proved by the action of certain poisons upon them. We know that they are poisoned like animals; arsenic, mercury, copper, lead, and tin, destroy them, and are found to be taken up by their vessels. Carbonic acid, azote, nitric oxide, hydrogen, when applied to the roots, are equally fatal. Opium, prussic acid, belladonna, nux vomica, menispermis coculus, hemlock, digitalis, alcohol, and oxalic acid, are no less so; and, because these destroy the life of animals without leaving chemical traces, and affect the nervous system, Dr. Marcet, jun., whose experiments will be found in the *Annales de Chimie*, June 1825, and are confirmed by many others, concludes that they must destroy vegetables by acting on a nervous system in them. But, although no trace be discoverable, this may be on account of their chemical peculiarities, (and, in fact, prussic acid and alcohol have been found absorbed, *Annales de Chimie*, Oct. 1814, and Dr. Cooke *on Apoplexy*,) and they, as well as other poisons, affect the nervous system of animals only as one part of the *living* body, — arsenic, besides its general deleterious agency, causing particularly gastritis, even if applied to a sore of the leg, digitalis exciting the kidneys (indeed their action on vegetables might, on the other hand, be urged as a proof of their *general* hostility to *life*); and the mineral ones, which often leave chemical traces, also produce peculiar effects on the nervous system, and often destroy life without being detected beyond the alimentary canal.

of the brain or spinal chord of course cannot be requisite, if there is no motion in the sympathy, nor any influence transmitted by nerves of voluntary movement. To the individual sympathy between the brain or chord these and their nerves must be indispensable, as in this respect they stand exactly in the condition of all other sympathising parts. When sympathetic pain is felt, brain and encephalo-spinal nerves must be required, the latter to communicate and the former to take cognizance of the sympathetic condition of the part in which the sympathetic pain is felt. But this is not an agency of the brain, chord, or encephalo-spinal nerves in sympathy: a sympathetic change first occurs in the part, and this is then felt by the encephalo-spinal system. If the ganglionic nerves have the office, assigned to them by so many writers, of giving vital properties to all parts, and not this, authors can hardly suppose that peculiar nerves for sympathy exist, seeing that all the other than the ganglionic are nerves for sense or motion or convey the influence of emotions from the brain: and, should distinct nerves for sympathy exist, I still cannot believe that the ganglionic system is for vitality on account of the reasons given above; and much less when I consider that its ganglia and nerves contain a large quantity of fibrils from the encephalo-spinal nerves of both sensation and motion; which very circumstance, I may remark, prevents me from believing that the anterior spinal nerves serve for motion only,—have no other function. I can conceive that the posterior are for transmission *to* the brain and chord only,—for sensation and for insensible influence, as when something unfelt in the stomach produces hiccup from the irritation being conveyed to the roots of the phrenic nerves: that the posterior are for transmission *from* the brain and chord; not however for the transmission of volition only, but of the influence of emotion and of excitement of their roots however induced. If we cannot always explain the occurrence or absence of sympathy by nervous distribution, we must remember that we are imperfectly acquainted with this. Fibrils often seem to unite which afterwards prove to run side by side only: and, the more knowledge we have, the more distinct do we find the office of individual fibrils. "Often," says Gall, "the different filaments of the same nerve are very visibly different: not only different nerves but also the threads of the same nerve proceed from different ganglia placed in different situations. All the peculiarities are the same in the same nerves; they must therefore

depend upon a primitive difference of inner structure, and be essentially necessary for difference of structure: whence Baron Cuvier naturally concluded that 'nerves are not all entirely alike, and do not all convey one fluid, like the arteries, for example; but that there are in the structure and mode of action of each, some peculiarity relative to the functions and nature of the organ which they animate.' I should say not animate, but influence." [r]

Sir C. Bell teaches that certain nerves are destined for Respiration and the Expression of the passions. These he terms respiratory nerves; and says they are the pathetic or internal motor of the eye, the portio dura of the seventh or facial, the glosso-pharyngeal, the eighth or pneumono-gastric, the accessory, the phrenic, and the long subclavicular or, as he terms it, external respiratory. These all arise, he says, in a tract, by him called respiratory, beginning at the mesocephalon, and descending on each side between the anterior or motor, and the posterior or sensitive, portion of the spinal chord, and terminating about the middle of the back. Chaussier [s] had previously pointed out the lateral tract, as suggested by Le Gallois [t], especially the portion contained in the skull, and suspected respiration to depend much upon it.

It is undoubted that several of these nerves are concerned in respiration and actions in which respiration is affected,—in sneezing, coughing, &c., as well as in the expression of the passions, in laughing, crying, and the expression of rage, terror, &c. But why the nerves of voluntary motion which are concerned in these actions should be regarded as different from other nerves of voluntary motion, I cannot imagine. Respiration is accomplished by muscles as voluntary as any voluntary muscles, and moved by nerves as voluntary as any other nerves of voluntary motion. We inspire because prompted to do so by uneasy sensation, just as we move from an uneasy posture. The pathetic, facial, accessory, phrenic, and long subclavicular, differ in no point from other nerves of motion; by their means we contract at pleasure the muscles to which they are distributed: in truth, the superior oblique muscle of the eye supplied by the pathetic, and some, as the orbicularis palpebrarum, supplied by the facial, have no con-

[r] Gall, l. c. 4to. vol. i. p. 128. sq., and 8vo. t. vi. p. 312. sq., where he quotes this part of the first 4to. volume under the name of *Môn Traité sur la Différence des Nerves.*

[s] *Exp. Sommaire, &c.* 1807. [t] *Sur le Principe de la Vie.* 1812.

nection whatever with respiration. The motor nerves of respiration conspire in operation for a particular end. But so do the nerves of all other muscles: those of the lower extremity in walking, those of the upper and lower end of the trunk in rising from the recumbent posture. For any particular action whatever, instinctive or arbitrary, association of the action of the nerves of sets of muscles takes place. As to their action being instinctive and involuntary, the action of every voluntary muscle may be instinctive and involuntary; and is always involuntary if a motive of great strength exists. We breathe or wink unconsciously or involuntarily; so also may we run, withdraw an arm, leg, or whole body, unconsciously or involuntarily. It is true that respiration continues during sleep and a certain degree of coma; but other associated actions do the same which are voluntary. Patients will move any part unconsciously, if you make it uneasy during sleep: they will swallow in apoplexy till near death. Poor children, when fast asleep through fatigue, will continue to move their hands and fingers as if at work, even after the machines of their unprincipled employers have stopped.[u] Having begun any muscular actions, we continue them often unconsciously if our attention is directed to something else, and, on its ceasing to be so directed, we may be surprised to find what we are doing. Then as to the muscles supplied by these nerves being respiratory, there is hardly a muscle in the body which may not be respiratory. In dyspnœa, more and more muscles are employed in proportion to the difficulty, till at length almost every muscle of the four extremities may be called in to give assistance.— With respect to expression, every other voluntary muscle may give expression as well as those which are moved by the voluntary nerves above enumerated. In despair, we as instinctively wring our hands as we lengthen our features and bewail; in rage, we as instinctively clench our hands and toss our arms as we knit our brows and project our lips and vociferate; in joy, we as instinctively move briskly as we laugh; in surprise, we instinctively depress our lower jaw: — motions in none of which respiratory nerves have any share. I see no difference in the agency of these nerves and of all other nerves of voluntary motion. — Lastly, the glosso-pharyngeal appears now to be a pair not of motion, but of sense,

[u] *Report of the Factory Commissioners*, 1833. The inhuman facts detailed in this report cover our Christian country with shame, and may be retorted by Continental vivisectors with triumph against us.

and of a specific sense, — a deadly blow to the respiratory set of nerves; and the pneumono-gastric to be a pair both of sense and motion. The peculiarity of the improperly called respiratory nerves arising from a peculiar tract amounts to nothing, if these two nerves of sense also arise from it: and, if the other nerves do arise from a peculiar tract, still nothing can be inferred from the circumstance, since they are all voluntary nerves, and we have seen that their operations differ in nothing from those of all other voluntary nerves, when combinations of actions are required for particular voluntary or instinctive motions, or for the instinctive expression of the passions. The accessory, subclavicular, and phrenic, however, only are in general allowed to have the origin assigned to them by Sir C. Bell; and even the accessory is declared by Gall [x] to arise from the posterior (sensitive) roots of some spinal nerves. The respiratory tract, or column, is rather an anatomical fancy, for it is not always to be found, and the best anatomists deny its existence.[y] It thus appears to me that Sir Charles Bell's doctrine respecting the respiratory nerves is merely an untenable whim; and that his discoveries of the function of the ganglionic portion of the trigeminum pair, (its other portion having long before been assigned to motion by Paletta,) and of the facial, and of the excitement of motion on irritating the anterior roots only of the spinal nerves, — the whole amount, I believe, of his real contributions to the physiology of the nervous system, — are only sullied by his views of the functions of his respiratory set.[z] Even the two first of

[x] M. Manec says it often arises at a right angle from the posterior roots of some spinal nerves. *Anatomie Analytique.* Tableau.

[y] Dr. Spurzheim asked Sir C. Bell (*Appendix*, &c. p. 31.) whether it is true, i. e. whether it is not untrue, that "each lateral portion of the spinal marrow contains three tracts or columns, one for voluntary motion, one for sensation, and one for the act of respiration;" and "that a fasciculus may be traced down the spinal marrow between the sulci which give rise to the anterior and posterior roots of the spinal nerves." These are Sir C. Bell's words, in his *Exposit. &c.* p. 123. 129. — I said nothing of the origin of the anterior and posterior roots of the spinal nerves from an anterior and posterior lateral sulcus, when speaking of the anatomy of the chord, because Gall says he could find the posterior only and seldom lower than the first dorsal vertebra, and that the anterior roots do not proceed in a straight line and regularly, as M. Chaussier describes and represents in his plates, but confusedly, sometimes at one distance, sometimes at another, from the middle fissure; the very dots by which M. Chaussier represents the exits of the nerves, are farther from the middle line than the grooves. (Gall, 4to. vol. i. p. 61. sq.)

[z] Dr. Fletcher conceives that Sir Charles Bell is right, as far as he goes; yet

these three discoveries he has obscured by ascribing morbid phenomena dependent upon the motor branch of the trigeminus

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that the nerves arising from the respiratory tract serve not only for the sympathetic action, as he regards it, of respiration and the expression of the passions, but that they serve for the production of all sympathy and for the effects of instinct and the passions on the system; instinct being considered by him as a part of the passions, only attended by a desire and by actions adapted to a particular end, and the word passion being synonymous with emotion. The operation of passion or instinct and of sympathy may be regarded as the same: the various parts of the body sympathising only with the *brain* in the two first cases. Now instinctive actions may be actions of any voluntary muscles of the body, and their source must be certain parts in the brain, but the conveyance of the impression from these parts of the brain which are the seat of the mental operation must be to that other part of the brain or spinal chord whence the voluntary motor nerves which excite the respective muscles arise. No peculiar system of nerves is required farther for instinctive motion. Peculiar nerves or nervous fibres may exist in the brain and chord, or peculiar nerves may exist only between these and all parts of the body for the conveyance of the effects of the passions, and between the various parts of the body for their endless sympathies. Nervous communication there must be between all parts sympathising not through mere continuity, but the communications throughout the system by means of all the encephalo-spinal and ganglionic nerves are abundant enough for sympathy to occur between any two. Many of the very nerves which he regards as the specific agents of sympathy are voluntary nerves; the facial, pathetic, phrenic, are employed by our will; and I conceive that they no more excite muscles sympathetically than any other voluntary nerves, where the nerve is excited sympathetically through some other nerve communicating with their roots: the fact being that these nerves of motion may be stimulated at their source in the brain or spinal chord by the will, or by emotion or some other excitement operating sympathetically. Dr. Fletcher only makes it probable, in his own mind, that such general communications exist by these peculiar nerves. He argues, 1. That the respiratory system of nerves is likely to be distributed almost universally, because the ramifications of the pneumono-gastric are inextricably interwoven with the roots of the ganglionic nerves, which are presumed already by him to be universally dispersed by travelling with the blood-vessels, and which also reinforce every encephalo-spinal nerve, so that, wherever a ganglionic nerve goes, a so called respiratory twig may go likewise: this probable distribution of the pneumono-gastric nerve would be sufficient to establish the universal distribution of these nerves, though others of the set are probably very widely disseminated. In fish, the pneumono-gastric is universally distributed. This set of nerves have almost a common origin, so that by means of one's diffusion, the whole may be regarded as diffused. Thus the sympathy between the lungs and the respiratory muscles is maintained by the pneumono-gastric nerve distributed to the lungs and conveying the sensation of want of breath; by the phrenic and intercostals and accessory and external respiratory nerves, which are associated at their roots with it, and excite the muscles as well as by other muscular nerves, the pathetic, facial, and even

nerve to affection of the ganglionic portion and of the facial, and by considering the facial as exclusively controlling all motions

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those distributed to numerous muscles of the body when the irritation from dyspnœa is extreme. The pneumono-gastric and the rest of the set associated with it at their roots appear to maintain the sympathy between the heart and the rest of the system. — I reply that he allows the ganglionic nerves to be as widely distributed; and so indeed must be the nerves of sensation, for any vascular part of the body may show sensibility when inflamed.

2. He argues that the nerves of sensation cannot convey sympathy, because this may occur independently of sensation and some sympathising parts have no sensibility.—But all vascular parts may acquire sensibility under inflammation, and therefore all vascular parts must have nerves of sensation. Yet sympathy may doubtless occur without sensation, just as the various nutritive functions occur without it. Still, if the ganglionic nerves are allowed by him to administer to these, *they* may administer to sympathy. Indeed, sympathy is often the result of sensation only. We do not sneeze unless the sensation in the nose arises to a certain height, — not the sensation of smell, but of touch; and I may remark that Dr. Fletcher appears wrong in arguing that sensation in the nose does not occur before sneezing, because it is not the sensation of smell. Some sympathies are sensations and therefore carried on in some measure at least by nerves of sensation; other sympathies certainly can have nothing to do with nerves of sensation, but it does not follow that they must be carried on by the so called respiratory nerves.

3. The occurrence of sympathy during sleep he considers an argument that sympathy is independent of the brain.—No one can doubt that many sympathies are independent of it. Communications of nerves exist independently of the brain: and Dr. Fletcher is correct in condemning the old hypothesis that the brain is necessary to sympathy. Still this does not show that the so called respiratory nerves must be the sole organs of sympathy.

4. He maintains that the manifestation of the effects of sympathy, passion, and instinct, are in proportion to the development of this system.—Certainly, in proportion to the *voluntary* muscles, which act under instinct and passion, are the nerves which serve these *voluntary* muscles. Fish, he urges, have, of the respiratory nerves, only the pathetic and the pneumono-gastric, which latter is in part a nerve of motion like the pathetic, and they have it of great size. Fish display the effects of many instincts and passions. Reptiles have, in addition, the glosso-pharyngeal and facial. Similar additions of other nerves are found in other classes. The glosso-pharyngeal, however, is now proved to be a nerve of special sense, and the facial supplies the voluntary muscles of the jaws and fauces, which in fish were supplied by the pneumono-gastric. But I can see here no argument for these voluntary nerves being exclusive agents of sympathy, although they are used as excitants of voluntary muscles under instinct and passion, and in morbid involuntary excitement of these muscles as well as in volition.

5. The structure of the sensiferous and ganglionic nerves is similar; and of

of the face concerned with respiration and expression, when the mere descent of the lower jaw which accompanies surprise proves the aganglionic portion of the trigeminus nerve to be, as almost any nerve of voluntary motion may be, a nerve of expression.[u]

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the motiferous and respiratory. As the motiferous convey a stimulus, so therefore probably do the respiratory.—Unquestionably those which are voluntary nerves are like all other voluntary nerves. Such are the facial, phrenic, and partly the pneumono-gastric, which are similar to the common motor of the eye, the abductor, and the hypo-glossal. This really tends nothing to the argument. Indeed the analogy does not hold with respect to all, for the glosso-pharyngeal, however similar in structure to nerves of motion, is a nerve of sense.

6. The sensiferous and ganglionic nerves do not transmit the galvanic influence; while the motiferous and respiratory transmit it with facility.—But this proves no more than the fifth argument; and I know not that all the latter do.

7. A stimulus applied to the trunks of these nerves occasions in general a display of irritation in parts sympathetically connected with them.—I believe this is the case with all nerves of motion, as well as those concerned in the motions of respiration. Stimulation of even nerves of sense will often excite those of motion which are sympathetically connected with them. Indeed, the acceleration of respiration after a time is said to follow the irritation of the glosso-pharyngeal — a nerve of only specific sense, as much as of the accessory and pneumono-gastric.

8. When the respiratory nerves are divided, the effects of passion and sympathy upon the parts which they supply are lost.—This is true of those which convey the effects of volition,—for this they can do no longer, nor, of course, can they convey involuntary any more than voluntary excitement to the muscles to which they run. But the fact amounts to no more than would be true of the division of any nerve of voluntary motion. The division of the glosso-pharyngeal can have no such effect, — for, being a nerve of sense, its sense (taste) only is lost in the part which it supplies. Various disturbances follow the division of the pneumono-gastric, but various ill effects also ensue upon the divisions of the sensiferous fifth.

Although I consider Dr. Fletcher's views equally unfounded with those of Sir C. Bell, I must not omit to mention that he puts them forth most candidly and rationally as purely hypothetical, and intended to give way to whatever shall be proposed of a more satisfactory nature.

It may be well to mention here that Sir Astley Cooper has lately published an account of the ligature of the two great sympathetic nerves in rabbits, and found no evident effect. One rabbit was killed at the end of seven days, when one nerve was found ulcerated through and the other nearly so; another rabbit was alive, at the end of a month, when the account went to press. (*Guy's Hospital Reports*, No. iii.)

[u] For his three discoveries Sir C. Bell deserves great praise, and his name will endure as long as the physiology of *these respective nerves*. But, when

credit is given him for having made discoveries, some of which belong to others, and some of which are no discoveries at all, but fancies; and when so much that to me is unintelligible, so much error, so much want of extensive knowledge, pervade his writings, I cannot refrain from smiling at the expressions splendid, brilliant, profound, luminous, and I know not what others, applied to his opinions by persons who cannot have considered the subjects laboriously, and only imitate one another in their belief and their language. The most ludicrous eulogy is in the *Report of the Third Meeting of the British Association.* Dr. W. C. Henry says, "The honour of this discovery (that there are distinct nerves of sensation and motion), doubtless, the most important since the time of Harvey, belongs exclusively to Sir C. Bell." (p. 62.) Now no new principle was discovered. We knew before that some nerves, as the optic and olfactory, were for sensation only, and some, as the common motor, the external motor, and the internal motor of the eye, and the lingual, for motion only. The only discovery was that two individual nerves were, one for the first function and the other for the second. That no one nerve could be for both sensation and motion had always been evident to reflecting minds. Galen taught his cotemporaries that one set of nerves went to the skin for sensation, and another to the muscles for motion. That Sir C. Bell had no idea that the anterior spinal roots were for motion only and the posterior for sensation only, is evident from the fact that above ten years after he had found motion to depend upon the anterior roots only, his able nephew, the late Mr. John Shaw, who lived with him and acted under him, published a paper * in which he says that his uncle is of the same opinion as Galen, and mentions the experiments of his uncle showing the connection of the anterior roots with motion, but has no idea that they are for motion only and not for sensation also, nor that the posterior are for sensation. His words are, — "These experiments we have often repeated, and always with the same results; but from the violence necessarily used in making them, it has been difficult to ascertain which of the filaments bestows sensibility on the part. It was easily shown that if only the posterior set was destroyed, the voluntary power over the muscles continued unimpaired, but the pain necessarily attendant upon the performance of the experiment prevented us from judging of the degree of sensibility remaining in the part." (p. 148. sq.) Now this paper was read on the last day of April, and printed in July, 1822, and Dr. Magendie's discoveries of the distinct functions of the two roots appeared in August (*Journ. de Physiol.*); so that, though Sir C. Bell refers to it in triumph (*Nervous System*, Preface, xxii.) as a proof that he had made the discoveries before Dr. Magendie, it proves precisely the reverse, and exhibits the imperfect state of his views up to the very time of Dr. Magendie's discoveries. Numerous as have been Dr. Magendie's physiological errors, humbly as I estimate his knowledge and reasoning powers, and much as I abhor his cruelty to brutes, I have never known him dishonourable; and I am satisfied that he knew nothing of Sir C. Bell's original discovery respecting the anterior nerves, for it was communicated in a pamphlet privately distributed: and as to the discovery of the office of the posterior roots, it, and thus the exact division of office between the two, is certainly Dr. Magendie's.

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* *Med. Chir. Trans.* vol. xii. 1822.

After all, I do not believe the whole discovered; because filaments from the anterior, as well as from the posterior roots, go to the sympathetic ganglia, and certainly not for motion. Gall had proved, in the last century, that distinct parts of the nervous system had distinct offices. This he taught in opposition to many of the most noted of his cotemporaries: he taught it with respect to the grand nervous organ — the brain, and with respect to the universal divisions of the nerves. (l. c. 4to. vol. i. p. 131. sq.) Sir C. Bell's discoveries are simply individual examples of Gall's great general principle in merely nerves. So little, however, does the gentleman entrusted to report for the Association know of Gall's discoveries, that he not only thus ventured to address it, but, after detailing the unsatisfactory vivisections of Messrs. Fleurens and Magendie, he passes Gall's labours over in silence, and gravely informs the assembled *savants* that there does not exist any conclusive evidence for referring separate faculties, or moral affections, to distinct portions of the brain." (p. 90.)! Phrenologists should really not allow the Association thus to expose itself.

Since the preceding sheets were printed, I have seen the paper by Professor Ehrenberg, alluded to *suprà*, p. 324. 325., in which he asserts, in opposition to M. Raspail, that, by means of the microscope, he has found the fibres of the encephalon, spinal chord, and nerves to be tubular. The following is pretty nearly his own summary of his observations: —

1. The fibrous substance of the brain consists not of solid fibres, but of parallel or fasciculated tubes, dilated at intervals, or jointed, and from $\frac{1}{96}$ to $\frac{1}{3000}$ of a line in diameter. Conveyed from the surface towards the ventricles and basis, increasing in size, and not united by any visible medium, they pass into the spinal chord, which they in a great measure constitute.

2. The brain, a central organ in function, is a peripheral in structure, as Gall had already remarked, and not to be compared with the heart or stomach as central organs.

3. The spinal chord of man, and of all great divisions of vertebrated animals, consists of tubes similar to those of the brain; but the finer tubes are placed more inwardly, the thicker outwardly. The thicker are continued into the cylindrical tubes of the spinal nerves.

4. The three soft (higher) special nerves of sense, — the olfactory, optic, and acoustic, and the sympathetic, consist of tubes which are collected into fasciculi and surrounded by neurilema. The three are immediate prolongations of the white matter of the brain: the sympathetic has a mixed structure of jointed and cylindrical tubes.

5. The jointed tubes of the brain, spinal chord, and articulated nerves, contain a perfectly transparent tenacious fluid, never visibly globular, the *liquor nerveus*, which differs from the *nervous medulla* as the chyle does from blood. Visible motion of this fluid has not been satisfactorily observed: a slow progression, however, is probable

6. All other nervous chords consist, not of jointed tubes, but of cylindrical

larger tubes, collected into bundles. These tubes are the immediate prolongations of the jointed tubes of the brain and spinal chord, for the most part suddenly changed and deprived of their dilatations, and are surrounded by neurilema. In the invertebrata they are from $\frac{1}{48}$ to $\frac{1}{1000}$ of a line in diameter: in the vertebrata from $\frac{1}{120}$ to $\frac{1}{240}$. They contain a granular, and, as it were, congealed, medullary matter, that by gentle pressure can visibly be forced out from them, after which they appear as empty sheaths, &c.

7. Hence the nervous substance consists of jointed tubes carrying the *liquor nerveus,* and cylindrical tubes with true *nervous pith.*

8. The brain does not consist of *nervous pith.*

9. The invertebrata do not possess a spinal chord consisting of jointed tubes without *pith;* or, in other words, the invertebrata *have no spinal chord,* although their abdominal ganglionic chord, which consists chiefly of cylindrical tubes containing *pith,* may perform the function of a spinal chord.

10. In the invertebrata the jointed cerebral substance and blood globules appear in much less proportion.

11. The jointed nervous tubes are, in relation to the human organisation and their distribution in the animal kingdom, the more important and *noble* part of the nervous system, and more immediately subservient to sensation.

12. Almost all cerebral terminations (only less obviously in the ear) are pervaded by a network of vessels, and contain large scattered globules, the size of which has a constant ratio to that of the blood globules in the same animal.

13. The structure of the retina, even in man, has been hitherto very erroneously described. The granular layer of the anterior surface of the retina is pervaded by a network derived from the central vessels. Behind this is placed the expansion of the optic nerve, which consists of jointed tubes, and separates into a peripheral cortical, and a central medullary matter. Many single, scattered, club-shaped bodies appear to moderate the luminous impression. Their connection with the jointed tubes of the nerve, Professor Ehrenberg could not clearly make out.

He confirms the discoveries of old anatomists mentioned above at page 341, respecting the pulpy (cortical) substance,—that it consists of a thick but delicate vascular network, and a soft substance; and the latter he pronounces to be finely granular, and to contain numerous insulated larger granules, which are composed of smaller ones, strung on filaments, as far as it was possible to observe them. Near the fibrous (medullary) portion of the brain, the filaments of the pulpy (cortical) substance become more and more evident, and the blood vessels somewhat larger and much less numerous. These observations greatly strengthen Gall's opinion of the pulpy (cortical) substance being the source of the fibrous (medullary): and Ehrenberg farther states, we see (12), that almost all the terminations of the cerebral nerves are again contained in a dense vascular network, with scattered globules, which he conjectures to be the *nuclei of blood globules,* especially as these in the pulpy substance of the brain are *proportionate to the size of the blood globules of the animal.*

Gall, it must be remembered, conceives that the nervous fibres originate, not only in the pulpy portion of the encephalon and chord, but in the peripheral extremities, where also pulpy substance, he urges, is found. In the pulpy portion of the ganglia, similar granules have been discovered by Ehrenberg, so

that at least one great use of the ganglia of the sympathetic, as of the encephalo-spinal system, may, with still further probability than I urged at page 451. *sq.* be to reinforce the substance of the nerves; and the opinion of Gall respecting the use of the pulpy substance of the nervous system, supported by his most powerful arguments, though rejected on the most silly grounds by Dr. Tiedemann, has acquired more probability than ever. The series appear to be externally abundant blood vessels, though fewer and fewer inwards; next granules, probably the nuclei of blood globules; and, lastly, the fibrous structure, now pronounced to be tubular.

Beobachtung einer auffallender bisher unerkannten Structur des seelenorgans bei Menschen und Thieren. Von C. G. Ehrenberg. Read Oct. 24. 1833. *Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin,* 1834.

CHAP. XX.

VOLUNTARY MOTION.

The processes of every living system, like those of inanimate nature, are carried on with *motion*.

"By ceaseless action all that is subsists." [a]

It is implied in the circulation, secretion, nutrition, and absorption of the minutest vegetable and animal; and, generally, when observation is possible, the solids, no less than the fluids within them, are seen in these functions to move.[b] Some contend, though without proof, that the nervous functions are performed with motion of a vibratary kind. The evident motion of the brain from circulation and respiration, and the very much larger quantity of blood constantly passing through the brain and other nervous parts than mere nutrition (unless each functional act causes waste of solids) can require, and this in proportion to activity of function, show that in one sense motion is indispensable even to nervous function. The other functions by which fresh substance from without is obtained, the blood purified, the new animal originated, and indeed all those other functions and modes of function which distinguish animals from vegetables, take place with manifest and considerable motion, and, though vegetables have not the power of locomotion, the leaves and flowers of many of them move rapidly and considerably. Now motions of the leaves, flowers, and vessels of plants are evidently the result of life, and are inexplicable by mere gravity, electricity, &c. No peculiar known structure is united with their movements. Some

[a] Cowper. *Task.*

[b] We witness vegetable fluids passing along surfaces and through cellular structure; and fluids in some adult animals through such a structure; and in all before a heart exists, or even vessels at the spot. Many declare that particles move spontaneously not only in blood (Dr. Tiedemann, l. c. cclxv.), but in the juices of plants (cclxxxvii.), (ccccIxxxiii. sqq.) (also dlxx.). Perhaps some of these motions are to be explained by the absorption and emission of fluid, some by evaporation, some by chemical processes altering the position of particles, and some by extraneous impulse. In many animals we shall see that the movements of fluids upon surfaces arise from the vibration of hair-like projecting bodies, termed cilia.

animals consist of substance as soft as mucous or gelatinous tissue; for instance, the polypi, most radiaria, some entozoa and the infusoria: yet the former will swim or crawl, attach or detach themselves, and seize prey; the infusoria swim rapidly, turn, and avoid each other, and possess distinct muscles. Sedatives and stimulants affect these movements of vegetables and of such animals like those of large animals. Such vegetables and animals, as well as minute insects and infusoria, which evidently perform what in large animals we should term muscular movements, show that living structure, though so soft that it cannot be regarded as precisely similar to the flesh of large animals,—to muscular fibre,—to what is termed muscle, is capable of living contraction. Such minute voluntary actions are attended, Raspail declares, in one infusory animalcule—the rotifer, by thickening during contraction of the muscular cylinders running from its head to its tail, and by tenuity of them when they lengthen.[c] In animals possessing muscles, many parts, not apparently muscular, contract, and instantaneously and forcibly, by a living force. Such are minute vessels and canals of all kinds. These lose their contractile power, like muscles, immediately or soon after death. Some structures are most adapted for contraction, as muscles; others not at all, as tendons and bones: but others, though not evidently muscular, possess the faculty in various degrees; and to expect distinct muscular fibre in every excitable part would be erroneous.

The vital power of motion, whether sensible, as in the heart and voluntary muscles and the leaves and flowers of many vegetables; or insensible, (except by its effect on contained fluids) as in the minute vessels of vegetables and animals, may have the term *excitability* restricted to it (see *suprà*, p. 25.), and thus will be distinguished from *sensibility*, to which the idea of motion is not necessary, as seen in the terminations of the optic and olfactory nerves, though motion may follow sensation; and sensation again is not necessary to motion, for not only do many animal motions occur without sensation, but vegetables are utterly destitute of sensation. The term *irritability* was peculiarly given by Haller[d] to the

[c] l. c. § 497. Dr. Tiedemann says that, with a microscope and strong lens, he observed contractions and expansions in the simplest infusoria, l. c. dlxxv. though previously he had asserted that neither could be detected in them, ccccIxiii.

[d] "See Haller on the irritable parts of the human body, *Commentar. Soc. Sc. Gotting.* t. ii.

excitability of parts which both move evidently from the application of stimuli, and possess distinct fibres; and he therefore said that muscles only are irritable[e], though other animal parts, as well as vegetables, possess excitability, — move independently of gravitation, or chemical or electric circumstances, or mechanical impulse. To deny this power, styled also by Haller *vis insita* or *propria*, to parts which may not show muscular fibres, or which may not move evidently on the application of a stimulus, would be absurd; yet Haller did this. To avoid confusion, the term myotility is given to the power of instant and evident contraction of fibrous parts on the application of a stimulus: it is

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And *Nov. Commentar. Gotting.* t. iv.

Among innumerable other writers on the same subject, suffice it to quote the following: —

Zimmerman, *De irritabilitate.* Gott. 1751. 4to.

Oeder, on the same. Copenhagen, 1752. 4to.

J. Eberh. Andreæ, on the same. (Præs. Ph. Fr. Gmelin.) Tubing. 1758. 4to.

As well as three entire Collections of writings which related to the great controversy excited throughout Europe in consequence of the Gottingen publications.

Sull' Insensibilita e Irritabilita, Dissertazioni transportate da J. G. V. Petrini. Roma, 1755. 4to.

Sulla Insensitivita ed Irritabilita Halleriana opuscoli raccolti da G. B. Fabri. Bologna. 1757—59. iv. vol. 4to.

And what were published under Haller's inspection, *Mémoires sur la Nature sensible et irritable des Parties du Corps Humain.* Lausanne, 1756—59. iv. vol. 12."

[e] Our countryman, Dr. Glisson, whose portrait we possess in the College of Physicians, was the first who absolutely ascribed animal movement to a specific power, which he termed irritability, (*De Natura Substantiæ energetica, seu de Vitæ Natura.* London, 1672. 4to.), — to a property of being influenced by excitants; and he distinguished it from sensibility. He pointed out that it might occur without sensation, with sensation, or through the will, — "Irritatio est perceptio, sed sensatio est perceptio perceptionis." Yet his facts, for his statements of the existence of such a *living* power were no theory but facts, found no supporters, Dr. Tiedemann remarks, (l. c. dxxvi.) "among his contemporaries, blinded as they were by the system of chemistry and iatro-mechanics, and were only justly appreciated in the following century."

Dr. De Gorter pointed out that the former is possessed by all parts of living bodies and by vegetables also. (*Exercitationes Medicæ quatuor.* Amstel. 1734. 4to. *Ex. Med. quinta.* Amst. 1748. 4to.) Dr. Glisson had allowed excitability even to the blood and humours, and Dr. Gaubius of Leyden afterwards did the same. (*Institutiones Pathologiæ.* Leyden, 1758. 4to. p. 169.)

synonymous with the two words — muscular contractility; but we must regard the power as the same with that which produces the motions of the minute vessels of all kinds of minute or gelatinous animals, and those rapid motions of some animal and vegetable parts which show no fibres, — we must regard it as a form of excitability. The term irritability should have a more extensive meaning than excitability: for, while this implies motion, irritability implies the general power of being affected by irritating causes, whether manifested by direct motion or by other changes which show either sensation or an operation distinct from what is seen in inanimate bodies: it is in truth vital affectibility in the largest sense.[f]

"The muscles, which are the immediate organs of by far the greater number of our motions, form the greatest bulk among all the similar parts."

"They are distinguished from other similar parts chiefly by two characteristic features, the one derived from their structure, the other from their remarkable powers.

"Their fleshy structure is formed of moving fibres, *sui generis*, and of a very faint red colour, and every muscle may be resolved into fibrous bands, these into bundles of fibres, and these again into very fine fleshy fibres and fibrils.

"Every muscle possesses a covering of cellular membrane[g], which is so interwoven witn its substance as to surround the bands, the bundles, and even each particular fibre and fibril.

"Every part of the muscles is amply supplied with blood-vessels and nervous threads. The latter appear to deliquesce into an invisible pulp, and unite intimately with the muscular fibres: the former are so interwoven with the fibres that the whole muscle is red and acquires its own paleness only by being washed.

"Most muscles terminate in tendons[h], which are fibrous[i] parts, but so different in colour, texture, elasticity, &c., as to be readily distinguished from muscles: thus disproving the opinion of some, — that the tendinous fibres originate from the muscular. This error arose chiefly from the circumstance of the muscles of infants

[f] In my own use of terms, at note (e) p. 24, 25. *suprà*, irritability and irritation, should be substituted for excitability and excitement.

[g] "See Ad. Murray, *De Fascia Lata.* Upsal. 1777. 4to."

[h] "See Fourcroy, *Mémoires de l'Académie des Sciences de Paris*, 1785, p. 392.; and 1786. p. 38."

[i] "Albinus, *Annotat. Academ.* l. iv. tab. v. fig. 2."

containing a greater number of fleshy fibres, in proportion to the tendinous, than those of the adult."

"They are in general divided into hollow and solid. The first, not directly subject to the will, belong more to the vital and natural functions." They are the heart, one of the coats of the alimentary and respiratory canals, of the urinary bladder, and of some blood-vessels; and are seen in a few other parts. They shorten and narrow the cavity or canal which they surround.

"Among the second," which are subject to the will, "there is much variety. For, not to allude to difference of size, there is great diversity in the disposition of their bands and fasciculi, the direction of their fibres, the proportion of the fleshy to the tendinous part, their course, mode of insertion, &c.

"The greatest number are long, and their fleshy bellies," lying outside solid parts, and passing over one or more joints, "terminate at each extremity in tendinous chords, inert, and destitute o contractility, and fixed to different bones, which, while contracting, they move in the manner of levers." The movable solids are drawn towards each other, if of equal mobility and size; if not, that which is movable or more movable and small is drawn towards the other.

"The commonly received law—that a muscle during its contraction draws the more movable point of insertion to the more fixed, must be considered, as Winslow justly remarks[k], perfectly relative and subject to various limitations. Thus, for example, sometimes the one point, and sometimes the other, may be the more movable, accordingly as the *united* action of many different muscles may render the opposite more fixed."

"While a very few muscles are destitute of tendons, such as the latissimus colli, an equally small number are not inserted into bones," but into soft solids, as into the lips, palate, tongue, pharynx, nose, eye, ears, genitals. These approach the hard part during contraction.

"A property common to all muscles is to become shorter, more rigid, and generally unequal, and, as it were, angular, during contraction," gaining in thickness what they lose in length. Dr. Tiedemann argues that, in contracting, a muscle acquires greater density, because it will support or raise a weight which would tear it after death. This, however, shows only the more

[k] "*Mém. de l'Acad. des Sc. de Paris.* 1720."

perfect composition of the part during life than after death. A muscle, however, may act, without shortening or growing thicker. If we hold, or act upon, a resisting body without moving it, the muscle, though in action, does not shorten. Again, a muscle may be made to shorten without contraction. We can bend the extremities of a person asleep, and thus his flexors be passively shortened.

"To attempt, with J. and D. Bernouilli and other mathematical physicians, to reduce the shortening of muscles to a general admeasurement, is rendered impossible, by the great difference, among other causes, between the hollow and solid muscles in this respect, and between the solid muscles themselves, *v. c.* between straight muscles (such as the intercostals) and sphincters."

Some have peculiar actions, dependent upon figure, situation, &c., "and, consequently, varying so much as to be referable to no general laws.

"To cite one instance out of many, that action of certain muscles is peculiar and anomalous which seldom occurs alone, but nearly always *subsequently* to, or *simultaneously* with, the action of some of a different order. Such is that of the lumbricales, when, during rapid motions of the fingers, they follow the action of other muscles of the metacarpus and fore-arm; and of the lateral recti muscles of the eyes, the adducens of either of which seldom acts unless simultaneously with the abducens of the other eye.

"And, on the other hand, although the action of the flexors is generally so much stronger than that of their antagonists — the extensors, that, when the body is at rest, the arms, fingers, &c. are a little bent, this does not so much depend upon the strength of the contraction of the flexors, as upon the voluntary relaxation of the extensors for our own relief.

"Every muscle has, moreover, a peculiar *mechanism*[1], adapted to the individual motions for which it is intended.

"Besides the determinate figure of each, many other kinds of assistance are afforded to their peculiar motions, *v. c.* by the *bursæ mucosæ*, chiefly found among the muscles of the extremities; the annular ligaments by which some are surrounded; the fat in

[1] "P. J. Barthez, *Nouvelle Méchanique des Mouvemens de l'Homme et des Animaux.* Carcass. 1798. 4to."

which most are imbedded; the lymphatic vapour around each; and, above all, by the conformation of the skeleton, chiefly in regard to apophyses, condyles, and articulations; nay, even whole bones, *v. c.* the patella, the pisiform of the carpus, and the sesamoid bones[m], are destined solely to facilitate the actions of certain muscles.

"In this mode is compensated, or, at least, diminished, that inevitable loss of power which necessarily takes place from the conformation and stature of the whole system, as, from the acute angle at which some muscles are inserted, or the proximity of their insertion to the centre of motion, much of that power is lost which would have existed, if their insertion had been more remote or at a more obtuse angle.[n]

"The human body, possessing about 450 voluntary muscles, or upwards, according to sexual or individual variety, is thus furnished with a double advantage, — with an extreme agility of motion in particular parts and throughout the whole, and with a surprising degree of strength and endurance of labour. Both these are accomplished partly by the perfection of the muscles that, like the perfection of the bones, takes place at manhood; and partly by habit and practice, the power of the former of which in affording strength and agility to the muscles is demonstrated in rope-dancers, leapers, runners, wrestlers, porters, savages, and the examples of ancient nations."[o]

When a muscle has ended its contraction, antagonising muscles, the elasticity or gravity of parts, solid, fluid, or gaseous contents pushed forwards from the higher portions of the canal, &c. &c., are enabled, through its diminished resistance, to elongate it. The mere cessation, however, of its contraction must be supposed to lengthen a muscle. For if, while under the exertion of a force drawing it together it is of a given length, this cannot remain the same when this force is no longer exerted. But any great elongation of it is accomplished by antagonising powers. When the heart has contracted, its relaxation is said, as we have seen, to be

[m] "Hence, of all animals which I have dissected, the mole is supplied with the most remarkable apparatus of sesamoid bones; its anterior palmated feet, with which it digs, have many of these bones, which greatly facilitate the action of the brachial muscles."

[n] "Gilb. Blane, *On Muscular Motion*, p. 51."

[o] "I have treated on this point at large, in the *Medic. Biblioth.* vol. ii. p. 407."

attended with an active enlargement of the organ forcing it energetically against the hand if placed upon it.

We will now consider the anatomy and physiology of the ultimate muscular fibre. Mr. Hare affirms that, in the field of a moderately powerful microscope, a muscular fibre evidently appears made up of numerous minute tubes, each exhibiting longitudinal striæ with transverse bands; the average diameter of each of these ultimate fibres or tubes being $\frac{1}{400}$ of an inch.[p] Under contraction, the portions between the transverse bands draw the latter nearer together, and, swelling out, seem girted by them, so that the whole fibre somewhat resembles a string of eggs. This appearance, Mr. Hare supposes, led Dr. Croon to adopt the idea that the ultimate fibre of muscle was constituted by a chain of bladders filled with fluid. In fact, Mr. Bauer thinks he discovers muscular fibres to be chains of globules[q], and Prevost and Dumas declare the same from their microscopic observations.[r] The muscular tubes are represented by Mr. Hare as filled with a matter which causes them to appear solid till it is liquefied by heat: Mascagni describes the muscular fibre as a small cylinder, filled with glutinous matter.[s] Fontana asserts that the primitive muscular fibre is marked by continual minute crispations and nodosities, and that it pursues a straight course, but is solid like the tendinous. Meckel, Rudolphi, and Tiedemann believe the primitive muscular fibre solid. Dr. Hodgkin found it not to consist of globules, and to be marked by transverse lines, which he thinks distinguish muscular from all other fibres. Raspail, like Mr. Hare, corroborates the assertion of Mascagni. He declares that every muscle, like the adipose texture and vegetable organs in general, consists of cells inclosed within each other in an indefinite series; but that, whereas their cells approach to a spherical form, those of muscle are cylindrical. The ultimate cylinders are closely applied to each other in very loose spirals round an imaginary axis; and each is full of a substance not completely miscible with water; and here and there globules appear irregularly, in contact with the inner surface. In the bullock,

[p] Thomas Hare, *A View of the Structure, Functions, and Disorders of the Stomach*, &c. p. 28. sq. 1821.

[q] *Phil. Trans.* 1818. J. F. Meckel, by microscopical observations, fancies the muscular no less than the nervous fibre, and the substance of the liver, kidney, spleen, &c., to be globular.

[r] *Annales de Chimie*, t. xviii.

[s] *Prodromo.* p. 97.

each cylinder is ·002 of an inch in diameter, and slightly crimson.[t] A bundle of cylinders is enveloped in a membrane; and such masses are enveloped in another membrane; these larger masses in others; till all have one general outer covering, which is usually white and hard towards its extremities, and terminates in a white shining chord called tendon and inserted into periosteum.[u] The fibres of tendon are said to be really solid, of infinitely smaller diameter, and disposed in a reticulated manner. Even cellular membrane is said to consist of reticulated tubular fibres, $\frac{1}{1000}$ of an inch in diameter on the average, and exhibiting transverse contractions.[x] Fontana, by means of glasses of moderate powers, found tendon to be composed of bands, which again are composed of solid spiral cylinders, of uniform size, and pursuing a tortuous course.[y]

M. M. Prevost and Dumas assert that the muscular fibres, straight while at rest, approximate each other at intervals, under contraction, so as to acquire a zigzag course (/\/\/\/) and shorten the distance of their two extreme points[z]; and thus Dr. Hales remarked that, when the abdominal muscles of a frog contracted, "the scene instantly changed from parallel fibres to series of rhomboidal pinnulæ, which immediately disappear as soon as the muscle ceases to act."[a] They ascertained satisfactorily that during contraction no increase of volume is acquired If muscles, while the fibres are straight, are stretched still more, as continually happens in the muscular coats of cavities, the subsequent shrinking to the original dimensions is unattended by the zigzag appearance. Nervous filaments, they also assert, go perpendicularly to the muscular fibre at the very points where the angles are formed under the zigzag contraction, and yet not to terminate there or unite with the muscular fibres, but to return to the same nerve or anastomose with other nerves. The approximation of the nervous filaments to each other is thought to draw the muscular fibres into angles, and thus be the cause of muscular contraction. But Raspail objects that it is hard to conceive how

[t] "The ultimate muscular filament has been estimated at $\frac{1}{4000}$ of an inch in diameter: their union forms fasciculi. Prochaska says that 200 fasciculi form a bundle; these are from $\frac{1}{8}$ to $\frac{1}{10}$ of an inch in diameter." Dr. Tiedemann, l. c. p. 418. additional notes by Drs. Gully and Hunter Lane.

[u] *Nouveau Système*, § 490. sqq.

[x] Mr. Hare, l. c. p. 36.

[y] *Sur les Poisons*, t. ii. p. 230. sq.

[z] Dr. Magendie's *Journal de Physiologie*, t. iii.

[a] *Hæmastatics*, p. 59.

elastic filaments could form lines so sharply angled; that he himself could not distinguish by the microscope which filament belonged to nerve and which to muscle; and that, if MM. Prevost and Dumas did see something like what they represent, their experiment was worth nothing, because, the muscular lamina being in contact with the object-holder in many points, any tremor caused mechanically or by galvanism applied to the nervous fibre would produce sinuous movements which afterwards were supposed more or less regular and angular. In short, he truly says that the only rational mode of observation is with a living muscle in action; that he has carefully watched the contraction of the muscles of the feet of gasteropoda, &c. and always found the fibre simply shorten, its diameter increasing at the time and small swellings appearing throughout its length.[b]

Dr. Wollaston[c] states that muscular contraction is accompanied by a *vibratory* sound like that of carriages passing rapidly over a pavement at a distance; and infers that it is not continuous but intermitting, consisting of a number of contractions repeated at extremely short intervals: and he fancied that such vibratory alternations might be about twenty or thirty in a second. He applied the ball of the thumb to the ear, pressing the end of the thumb at the same time against the head. As soon as the thumb is bent so as to press against the head, the noise is heard; and I find it far louder if both thumbs are used at once, and still louder if the jaws are at the same time tightly closed. In regard, however, to the intermittence of muscular action, a friend informs me that the action of the muscles of the eye cannot intermit even the 2000th part of a second, because, if a luminous point is moved with rapidity perpendicularly, and the eye horizontally, the luminous line is not a zigzag, as it would be were there intermissions, but perfectly continuous.[d]

The muscles, voluntary and involuntary, of all animals in which a nervous system has been discovered, contain nerves; for the will operates by encephalo-spinal nerves on the voluntary muscles, and the stimulating contents of involuntary muscles do not act, except by distension, directly upon them, but upon a membrane

[b] l. c. § 494. sqq. [c] *Phil. Trans.* 1810, p. 2. sqq.

[d] Two curious cases are related in Dr. James Johnson's *Med.-Chir. Review*, Oct. 1834, of the action of muscles occurring with a cracking noise like that of snapping joints, and with pain.

which lines them, as in the case of the heart and blood-vessels, the alimentary canal, and other hollow muscles, nor does light act upon the iris but upon the retina, and the influence of emotions, sudden or continued, on the action of all involuntary muscular parts, whether large, like the heart and as in the alimentary canal, or minute, as in the capillary vessels, must be communicated by nerves. Some vivisectors say that a stimulus applied to the nerves of an involuntary part do not excite it; others assert the reverse. But any stimulus applied to a nerve belonging to a voluntary muscle, mechanical or pungent, heat or electricity, excites it instantly to action, and will excite it after pricking or cutting the fibres themselves has ceased to produce contraction.[e] Stimulation still further back, of certain parts of the chorda spinalis or oblongata, or of the brain, has the same effect. Division of the nerves or spinal chord, great compression, disintegration, any thing which prevents continuity of influence from the brain to the termination of the nerve in the muscle, destroy the power of the will. The contractility of the muscle is of course unimpaired; it contracts equally as before, if a stimulus is applied to it or to the portion of the nerve connected with it. Yet, some contend that the very power of contraction depends upon nerves. They adduce the influence of poisons, applied to the nerves, in destroying the irritability of muscles to which they are distributed, and declare that, even if strong poison is applied to the nerves of muscles detached from a living animal, the muscles cannot afterwards be excited.[f] But Fontana discovered that the portion only of the nerve that has been in contact with alcohol is incapacitated from conveying stimulus; so that, if the stimulus is applied to the nerve farther on, the muscle contracts as at first.[g] Even had not Fontana made this discovery, the effect could have been ascribed to the transmission only of the effects of the poison along the nerve, and could, like the effect of mechanical and all other irritation of the nerves upon muscles, have shown only the connection and influence between the two. Dr. Whytt discovered that, if an animal is poisoned by opium, the effects pervade the system much

[e] Whytt. *Physiol. Essays.* ed. 2. 1761. p. 249. *Sensibility.*

[f] Dr. Bostock. *Elemen. Syst. of Phys.* ed. 3. p. 179. Dr. Tiedemann, ccccxlii.

[g] This was fully confirmed, in regard to other narcotics, by Dr. C. Henry, *Edinb. Med. and Surgical Journal,* 1832. No. CX. p. 17.

more if the brain and spinal chord are entire, than if they are previously removed: and the inference is clear, that the nerves more readily transmit the effects of the poison than other parts, and not that the muscles lose their excitability through the loss of the nervous influence; because the destruction of the brain and spinal chord has not the effect of poison.[g] Another fact of the same kind is the immediate cessation of the action of the heart or of the intestines by the injection of poison into their cavities, while its application to their external surface operates slowly upon them.[h] Far greater nervous connection must exist between their inner surface than their outer surface and their muscular fibres, because these are destined for stimulation by their contents, and not by matters on the exterior; and thus the effects of poisons will be more readily transmitted by the inner than the outer surface, just like the effects of all stimulating causes. Detached muscles contract under the application of various stimuli of all kinds, and this looks as if their power of contraction is their own. When a detached muscle can be excited no longer, a little rest enables it to become excitable again: and the alternations may be repeated many times. Nay, if a muscle is not detached, but merely all its nerves divided so that its life is preserved, its excitability may be exhausted and recovered for some days.[i] The power continues longer after separation in cold than in warm blooded animals; in voluntary muscles than in the involuntary; and Dr. Whytt discovered, also, that, when an

[g] Whytt himself infers that "opium does not only destroy the moving power of the muscles of animals, by intercepting the influence of the brain and spinal marrow, but also by unfitting the muscular fibres themselves, or the nervous power lodged in them, for performing its office." "It destroys their powers, by means of that sympathy which they have through the brain or spinal marrow, with the nerves to which the opium is immediately applied." *Experiments made with Opium on living and dying Animals.* First published in *Ed. Physical and Literary Essays.* 1755. (r.)

I may remark that he found the nearest part of the nervous system to be the most affected; for, when a solution of opium was inserted into the large intestines, "dogs not only lost the power of motion sooner in their hinder legs than in their fore ones, but also were insensible of any pain in them, and yet howled strongly when their ears were pinched." (m.)

[h] Dr. Munro *Secundus*, and Dr. Wilson Philip; confirmed by Dr. C. Henry, l. c. Still Whytt found opium to poison the whole system sooner if injected into the peritonæum than into the stomach or rectum. l. c. Exp. 21, 22, 23.

[i] *Report of the Fourth Meeting of the British Association.* 1835. p. 671. sqq.

animal is poisoned by opium, the actions of the involuntary muscles of the heart and intestines continue after the voluntary muscles have ceased to contract on the application of the scalpel[k]; the power continues longer in the muscles of the young than of the old; of the well fed than of the ill fed; in warmth than in cold; in atmospheric air and oxygen than in irrespirable gases; and strong stimuli, chemical agents, or narcotics, applied to either muscles or their nerves, rapidly annihilate their powers.[l] Repeated stimulation exhausts a muscle more slowly if its nerves have been divided, because, while the nerves are in connection with it[m], the stimulus affects them also and thus the muscle indirectly as well as directly. If the power of contraction depended on the nerves, the division of the nerves, by cutting off the supply of power, should hasten exhaustion. Vegetables have no nerves, and yet exhibit striking movements. If a muscle, in a mean state of extension, is divided transversely in the living body, the two portions instantly separate; and Bichat found that they separate just as far if its nerves have been previously divided,—another fact in harmony with the opinion of the contractility of muscles being inherent. To ascribe muscular excitability to the nervous system, is but an individual instance of the ascription of the vital properties of all parts to the nervous system,—an opinion which I endeavoured to refute at page 431. sqq. *suprà.*[n] Still the contraction of voluntary muscles is not only excited by nerves at the moment of volition, but preserved constantly to a certain point by the encephalospinal nerves of motion, because, if connection with them is destroyed, or the portion of the encephalon or spinal chord with which they unite is disorganised or compressed, the antagonist muscles, as those of the face, overpower them, or the sphincter of the rectum or bladder is no longer able to retain. Thus in hemiplegia the muscles of the mouth half draw their antagonists

[k] Of course galvanism to their nerves is equally inoperative. Dr. C. Henry, l. c. p. 16.

[l] Dr. Tiedemann, l. c. ccccxlv.

[m] Dr. Wilson Philip, *Exp. Inquiry*, p. 100.

[n] Whytt, in opposition to Haller, contended that the susceptibility of excitement in muscles,—the recognition of stimulus,—depended altogether upon their nerves; and that stimuli excite them by producing an uneasy feeling in them or their nerves. *Essay on the Vital and Involuntary Motions of Animals.* Edinb. 1751.

towards them: in perfect paraplegia, the sphincters of the rectum and bladder no longer retain their respective contents. Some persons, as Cuvier, and since him Dr. Tiedemann, allow excitability to be inherent in muscles, but contend that it is always acted upon through the medium of nerves. It is, however, a mere assumption that, if stimulus can be applied to muscular structure, directly, the presence of nerves is indispensable. Distension acts directly on the muscular fibres; but, with this exception, the functions of muscles are excited intermediately, and therefore through nerves.

The constant tension of muscles is called their tone. After the retraction of the two portions of a divided muscle, these will contract further on stimulation, and relax again to the length they had after retraction. If overstretched, as by a tumour or other cause, muscles lose much of their forced length immediately on the removal of the cause, but may not completely recover for some time; and such shortening is said by Prevost and Dumas not to be accompanied by a zigzag direction of their fibres, though this appears in them as soon as farther contraction is excited by galvanism. If a muscle not overstretched is divided transversely in several places before its life has ceased, each portion necessarily retracts and necessarily grows harder and heavier. When this is done with fish, it is called crimping, and the retraction is, as might be expected, heightened by immersing the portions in cold water. When fish are to be crimped, they are knocked on the head as soon as caught, that they may crimp the better. This impairment of their nervous powers preserves the power of the muscles, which would otherwise be lost in the struggles of the poor animal: but, if the contractility of muscle depended upon nervous energy, it should impair the effects of crimping. This retraction on transverse division takes place only during life or very soon after death, because muscles grow rigid when life has ceased. The latter rigidity is unattended by contraction: it is a mere consolidation, and unfits the fibres for contraction from any cause. Mr. Mayo says that the injection of warm water into the arteries of a muscle induces sudden rigidity.[o] I presume that, like the coagulation of the blood or of albumen, it is a merely chemical change. When death occurs under circumstances which prevent the coagulation of the blood, the rigidity of the muscles is said to be equally prevented.

[o] *Outlines of Human Physiology*, ed. 3. p. 38.

If a muscle has been much distended, it does not contract readily at first. This we notice in the case of the urinary bladder: when the urine has been retained too long it stops, after flowing for a short time; and flows again when the bladder has a little recovered itself. Leeuwenhoek believed that over-distension of the heart might cause sudden death : and he probably was right, for sometimes nothing is seen in cases of sudden death but extreme distension of the right half of the heart, and Professor Coleman, after hanging and drowning animals, found the right auricle and ventricle turgid with blood, and the auricle insusceptible of irritation; but, on opening one of its veins and allowing blood to escape, the application of stimulus in a few minutes induced contraction of the auricle.[p] Pressure upon a muscle facilitates its action. Thus the over-distended bladder, and the uterus after delivery, contract better if the hand is placed over them; and a moderate ligature is often employed by those who are about to make much exertion with particular muscles.

When a muscle is weakened by excessive action, a peculiar unpleasant sensation is experienced, termed fatigue. The weaker the system, the sooner is this sensation experienced. General weakness at the commencement of disease is usually attended by this sensation of weariness, though, when disease is over and mere weakness remains, it is commonly not felt till exertion is made. Distress of mind will bring on this sensation. When a set of muscles is much more exercised than usual, they at first become stiff and painful: but these conditions soon cease, notwithstanding equal exercise is persevered with.

All muscles increase by use; so that, if a man has spent much of his life in some mechanical occupation which requires the action of particular muscles, these are easily distinguished through their disproportionate magnitude. It is thought that the muscular fibres of the urinary bladder increase by exercise more than any others; a continued obstruction to the exit of the urine calls them into such exertion that the inner surface of this organ often resembles that of a cardiac cavity. The heart also frequently grows inordinately from obstruction to the exit of its blood. But this organ, above all other muscular parts, will grow inordinately from mere morbid disposition. In the heart this hypertrophy may produce much distress, if any undue excitement occurs;

[p] *Lectures on the Blood*, by James Wilson, F.R.S. London, 1819.

whereas, in another muscle, the overgrowth may be a matter of no importance. In different persons, different muscles may be better developed and stronger than others: and some persons have their general voluntary muscular system remarkably developed. When this is the case, there is usually a disposition to employ the more powerful parts freely, and thus exercise farther augments them. From the most ancient times some men have performed extraordinary feats of strength. Milo of Crete, after killing an ox with his fist, carried it through the stadium,—a space of 625 feet; and, when the pillar which supported the roof of his master's school gave way, he saved Pythagoras and the scholars from destruction by supporting the roof himself till they escaped. The Jews had their Sampson; and at our shows I have seen a man support a table with many persons upon it and even carry it some little distance between his teeth. Muscular strength appears by Dr. Edwards's experiments to vary at different periods of the day, and to be much affected by diet. By means of the dynamometer he found it increase during the first half of the day, and decrease during the latter; to be instantly increased by a moderate and nutritious meal, except in the weak, in whom the immediate effect of a meal was depression of the strength. Mere water, especially warm, and sugar and water, also instantly diminished the strength. Gelatine, well flavoured with the skin and odorous parts of meat, gave the greatest strength.[q]

The muscles are usually divided into involuntary and voluntary,—those which we have not ordinarily the power of directly contracting, and those which we have ordinarily the power of directly contracting. The action of the heart and all vessels, canals, and cavities, except the outward opening of some, is involuntary: that of most other muscles, voluntary. The mind, however, though not its will, powerfully affects involuntary muscles. Under emotion, the action of the heart may be excited or depressed: any one part may grow turgid and red or shrink and grow pale: and by thinking, voluntarily, of circumstances calculated to excite such emotions, we may voluntarily, in this indirect manner, affect the action of involuntary parts, and even without thinking of circumstances affecting ourselves, but by only dwelling on the circumstances of others,—as in reading. Betterton the actor, when playing Hamlet, could cause

[q] Read in the Academy of Arts and Sciences at Paris, Feb. 11. 1835.

his face at once to become bloodless.[r] Blumenbach says he has seen "some persons able, at any time, to produce a spasmodic horripilation of the skin, by representing some unpleasant object to their imagination. Others have had the power of exciting local sweat in the hands, &c."[s] Strong feelings and a strong power of attention may render many involuntary parts thus indirectly voluntary.[t] Whether strong attention explains the power which some possess over the iris, I do not know.[u] The distribution of its nerves is sometimes unusual, and this may render it directly voluntary. Blumenbach says he once found "the action of the stomach distinctly voluntary in a ruminating man." Unusual distribution of nerves may occur any where just as of arteries: and, if a nerve of voluntary motion should run to a muscle intended to be involuntary, this would become voluntary.[x]

[r] *Penny Cyclopædia.*

[s] "See, for instance, T. Bartholin, *Act. Hafniens.* 1676. vol. iv. p. 191."

[t] "See the *Rapport des Commissaires chargés par le Roi de l'Examen du Magnétisme Animal*, written by J. Sylv. Bailly, a man worthy of a better fate. Paris, 1784. 4to. p. 16."

[u] Belingeri informs us that Mascagni found the iris voluntary in Fontana. *Dissertatio Inauguralis*, P. ii. §. xxi.

[x] Dr. Cheyne, in his *Treatise on Nervous Diseases*, p. 307. sq., relates the following case, which is often adduced as an instance of voluntary power over the heart. If it was, this power had not always existed, nor could it be exerted at once as over voluntary muscles: and probably the mental influence was indirect.

"Colonel Townshend, a gentleman of excellent natural parts, and of great honour and integrity, had for many years been afflicted with a nephritic complaint, attended with constant vomitings, which had made his life painful and miserable. During the whole time of his illness he had observed the strictest regimen, living on the softest vegetables and lightest animal foods, drinking asses' milk daily, even in the camp; and for common drink Bristol water, which, the summer before his death, he had drunk on the spot. But his illness increasing and his strength decaying, he came from Bristol to Bath in a litter, in autumn, and lay at the Bell Inn. Dr. Baynard and I were called to him, and attended him twice a day for about the space of a week, but his vomitings continuing still incessant and obstinate against all remedies, we despaired of his recovery. While he was in this condition, he sent for us early one morning; we waited on him with Mr. Skrine his apothecary; we found his senses clear and his mind calm; his nurse and several servants were about him. He had made his will and settled his affairs. He told us he had sent for us to give him some account of an odd sensation he had for some time observed and felt in himself, which was, that composing himself, he could die or expire when he pleased, and yet by an effort, or somehow, he could come to life again; which it

On the other hand, there is no voluntary muscle that may not act involuntarily. If the motive to contract a muscle is very

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seems he had sometimes tried before he had sent for us. We heard this with surprise; but as it was not to be accounted for from now common principles, we could hardly believe the fact as he related it, much less give any account of it, unless he should please to make the experiment before us, which we were unwilling he should do, lest in his weak condition he might carry it too far. He continued to talk very distinctly and sensibly above a quarter of an hour about this (to him) surprising sensation, and insisted so much on our seeing the trial made, that we were at last forced to comply. We all three felt his pulse first: it was distinct, though small and thready, and his heart had its usual beating. He composed himself on his back, and lay in a still posture some time; while I held his right hand, Dr. Baynard laid his hand on his heart, and Mr. Skrine held a clean looking-glass to his mouth. I found his pulse sink gradually, till at last I could not feel any by the most exact and nice touch. Dr. Baynard could not feel the least motion of his heart, nor Mr. Skrine the least soil of breath on the bright mirror he held to his mouth; then each of us by turns examined his arm, heart, and breath, but could not by the nicest scrutiny discover the least symptom of life in him. We reasoned a long time about this odd appearance as well as we could, and all of us judging it inexplicable and unaccountable; and finding he still continued in that condition, we began to conclude that he had indeed carried the experiment too far, and at last were satisfied he was actually dead, and were just ready to leave him. This continued about half an hour, by nine o'clock in the morning, in autumn. As we were going away, we observed some motion about the body, and upon examination, found his pulse and the motion of his heart gradually returning: he began to breathe gently, and speak softly: we were all astonished to the last degree at this unexpected change, and after some further conversation with him and among ourselves, went away fully satisfied as to all the particulars of this fact, but confounded and puzzled, and not able to form any rational scheme that might account for it. He afterwards called for his attorney, added a codicil to his will, settled legacies on his servants, received the sacrament, and calmly and composedly expired about five or six o'clock that evening. Next day he was opened (as he had ordered): his body was the soundest and best made I had ever seen; his lungs were fair, large, and sound; his heart big and strong, and his intestines sweet and clean; his stomach was of a due proportion, the coats sound and thick, and the villous membrane quite entire. But when we came to examine the kidneys, though the left was perfectly sound and of a just size, the right was about four times as big, distended like a blown bladder, and yielding as if full of pap; he having often passed a wheyish liquor after his urine, during his illness. Upon opening this kidney, we found it quite full of a white chalky matter, like plaster of Paris, and all the fleshy substance dissolved and worn away, by what I called a nephritic cancer. This had been the source of all his misery; and the symptomatic vomitings from the irritation on the consentient nerves, had quite starved and worn him down. I have narrated the facts, as I

strong, we may not be able to refrain from willing its contraction; just as a very strong motive may involuntarily impel us to will any mental operation. If you cause strong pain or titillation in a person, he will be compelled, whatever restraint he may attempt upon himself, to cry out or laugh, and to make an effort to remove it by motion of some part. We are instinctively and almost unconsciously led to will suitable motions, and if, as usually is the case, we have no motive not to yield to the inclination, the motion takes place almost without the appearance of our will. It is thus that we breathe and wink all day. The respiratory muscles deserve the epithet voluntary as much as any in the body, for we directly contract them[y]: we feel an uneasy sensation in the chest from the retardation which occurs to the blood, and we inspire to remove it; the uneasiness being removed, our effort ceases, and expiration spontaneously ensues. The necessity for sighing after reading or listening attentively arises from our having forgotten to breathe fully,— not having fully perceived the want of breath while our attention was so occupied[z]; and the general coughing and sneezing in church at a pause in the sermon are owing to the sensations which give rise to those actions having been for a time overpowered throughout the congregation by other feelings.[a] It is true that respiration continues while we are asleep, and that the uneasiness is so great that we are forced to inspire.[b] But the same is true of all voluntary muscles.

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saw and observed them, deliberately and distinctly, and shall leave to the philosophic reader to make what inferences he thinks fit; the truth of the material circumstances I will warrant."

M. Ribes is said to have published a similar case: but I have not been able to find it.

[y] This is the opinion of Haller, and ably defended by him. *El. Physiol.* t. iii. lib. viii. § 18.

[z] Dr. Darwin, *Zoonomia,* vol. i.

[a] Dr. Alison's Observations on Sympathy in the *Edinburgh Med. Chirurg. Trans.* vol. ii.

[b] Opposite circumstances have an opposite effect. When the French soldiers drove the Piedmontese on the tops of the Alps between St. Bernard and Cenis, Parat and Martin say that the mouth and nose were involuntarily closed against the storm,— that all attempts at inspiration were fruitless, and, if they could not oppose the blast by turning round or putting the hand to the mouth, they fell down giddy and died. (*Mém. de la Soc. Méd. de Lyons.* 1798.)

First as to the continuance of respiration during sleep. If you irritate any part of a person asleep, an effort of some kind is made to withdraw from the source of uneasiness, and people turn in their sleep when uncomfortable; fowls perch on one leg, voluntarily contracting their claws before they go to sleep, and remain thus supported till they awake, though the bent condition of the claw is much preserved by mere mechanism. But men will sleep standing: somnambulists unconsciously perform astonishing muscular movements: and, while awake, we continue winking, coughing, and often continue walking, or performing other voluntary actions, while our minds are totally absorbed in reflecting and give no perceptible attention to our corporeal movements; a person will play even a rapid piece of music, familiar to him, while thinking and perhaps talking of something else, and forgetting that he is at the instrument, though originally each of the infinite number of volitions requisite to the performance may have been slow and laborious[c]: nay, a person may fall asleep after beginning a very habitual set of actions, and continue them,

[c] Dr. Whytt confounded mind and life, and, believing that they were an immaterial substance, and matter incapable of vital and mental properties or soul, ascribed all the functions of animal bodies, human and brute, to a soul diffused through every part. (*Of the Vital and Involuntary Motions of Animals.* 1751. sect. xi. obj. i.) But, notwithstanding this prejudice and hypothesis, he shows that volition may be exerted without consciousness. "Many of the voluntary motions are performed," he says, "when we are insensible of the power of the will excited in their production. Thus, while in walking, we either meditate by ourselves, or converse with others, we move the muscles of our legs and thighs, without attending to it or knowing what we are doing. We are not sensible of the eye-lids being kept open by the continued operation of the will; but yet, when drowsiness and sleep steal upon us, we find it requires a considerable effort to prevent the falling down of the superior palpebræ. The same thing is known of the muscles which support the head. The most probable account of our ignorance of these things seems to be this; — namely, that we not only acquire, through habit, a faculty of performing certain motions with greater ease than at first, but also, in proportion as this facility is increased, we become less sensible of any share or concern the mind has in them. Thus a young player upon the harpsichord, or a dancer, is, at first, solicitous about every motion of his fingers, or every step he makes, while the proficients or masters in these arts, perform the very same motions, not only more dexterously, but almost without any reflection or attention to what they are about. (Ib. obj. iii.)

Mr. Dugald Stewart's chapter on attention (*Elements of the Philosophy of the Human Mind.* 1792. ch. ii.) well deserves perusal, though published forty-one years after Dr. Whytt's Essay.

as we have seen in the instance of poor little children, who, when dead asleep, were observed still to move their fingers as if at

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" In the case of some operations which are very familiar to us, we find ourselves unable to attend to, or to recollect, the acts of the will by which they were preceded; and accordingly, some philosophers of great eminence have called in question the existence of such volitions; and have represented our habitual actions as involuntary and mechanical. But surely the circumstance of our inability to recollect our volitions, does not authorise us to dispute their possibility; any more than our inability to attend to the process of the mind, in estimating the distance of an object from the eye, authorises us to affirm that the perception is instantaneous. Nor does it add any force to the objection to urge, that there are instances in which we find it difficult, or perhaps impossible, to check our habitual actions by a contrary volition. For it must be remembered, that this contrary volition does not remain with us steadily during the whole operation; but is merely a general intention or resolution, which is banished from the mind, as soon as the occasion presents itself, with which the habitual train of our thoughts and volitions is associated.

" It may indeed be said, that these observations only prove the possibility that our habitual actions may be voluntary. But if this be admitted, nothing more can well be required; for surely, if these phenomena are clearly explicable from the known and acknowledged laws of the human mind, it would be unphilosophical to devise a new principle, on purpose to account for them. The doctrine, therefore, which I have laid down with respect to the nature of habits, is by no means founded on hypothesis, as has been objected to me by some of my friends; but, on the contrary, the charge of hypothesis falls on those who attempt to explain them, by saying that they are *mechanical* or *automatic;* a doctrine which, if it is at all intelligible, must be understood as implying the existence of some law of our constitution, which has been hitherto unobserved by philosophers; and to which, I believe, it will be difficult to find any thing analogous in our constitution."

" I cannot help thinking it more philosophical to suppose, that those actions which are originally voluntary, always continue so; although, in the case of operations which are become habitual in consequence of long practice, we may not be able to recollect every differect volition. Thus, in the case of a performer on the harpsichord, I apprehend, that there is an act of the will preceding every motion of every finger, although he may not be able to recollect these volitions afterwards; and although he may, during the time of his performance, be employed in carrying on a separate train of thought. For, it must be remarked that the most rapid performer can, when he pleases, play so slowly, as to be able to attend to, and to recollect, every separate act of his will in the various movements of his fingers; and he can gradually accelerate the rate of his execution, till he is unable to recollect these acts. Now, in this instance, one of two suppositions must be made: the one is, that the operations in the two cases are carried on precisely in the same manner, and differ only in the degree of rapidity; and that when this rapidity exceeds a certain rate, the acts of the will are too

work after the machinery had all stopped. (*suprà*, p. 460.) There is nothing surprising in this, if we consider the counterpart in regard to sensation. For that, on the other hand, we may have sensations and not be aware of them, is shown by persons falling asleep at church and remaining so during the sermon, but awaking as soon as the preacher's voice is silent. The effect of the cessation of the stimulus shows that the stimulus was all along felt.— These facts are true of all voluntary muscles: and so likewise are those of the facility of action where there is no habit but an instinctive impulse to will certain motions. In one sense all voluntary motions are instinctive: that is as far as men and brutes know nothing of their muscles, and do not determine upon contraction of these fibres or those, or of this combination of muscles or that, or upon the amount of contraction in each respective muscle, but upon such a movement as they choose of a

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momentary to leave any impression on the memory. — The other is, that when the rapidity exceeds a certain rate, the operation is taken entirely out of our hands; and is carried on by some unknown power, of the nature of which we are as ignorant, as of the cause of the circulation of the blood, or of the motion of the intestines. The last supposition seems to me to be somewhat similar to that of a man who should maintain, that, although a body projected with a moderate velocity, is seen to pass through all the intermediate spaces in moving from one place to another, yet we are not entitled to conclude, that this happens when the body moves so quickly as to become invisible to the eye. The former supposition is supported by the analogy of many other facts in our constitution. Of some of these, I have already taken notice; and it would be easy to add to the number. — An expert accountant, for example, can sum up, almost with a single glance of his eye, a long column of figures. He can tell the sum, with unerring certainty; while, at the same time, he is unable to recollect any one of the figures of which that sum is composed; and yet nobody doubts, that each of these figures has passed through his mind, or supposes, that when the rapidity of the process becomes so great that he is unable to recollect the various steps of it, he obtains the result by a sort of inspiration."

The rapidity of the volitions can afford no objection. "A person playing on the harp, dancing, and singing, at the same time, exercises about three hundred muscles at once. (G. Ent, *Animadv. in* Thrustoni *diatribam*, p. 130.)" In speaking, fifteen hundred letters may be distinctly pronounced in a minute, each requiring a separate volition. The rapidity of thought is still quicker. Rapidity, like minuteness, is only relative to what we commonly witness. An animal millions of times smaller than the minutest known microscopic creature might have as great a complexity of parts as ourselves; movement might be millions of times swifter than any thing we ever observed.

moveable part. In another sense all voluntary motions are instinctive, because, on the occurrence of certain wishes, of a certain strength, we perform certain motions: a person who dances, dances because his wish is at a certain height; a man who makes a machine, cuts and arranges its parts through the same cause. But some sensations, some states, cause us and brutes to will certain motions without habit or experience; and yet the occurrence of will is just as clear. The teat in the young animal's mouth causes it directly it is born to will suction. The only difference in this case is one of time: the particular sensation or state is, without habit or circuitous circumstances, at once followed by the action. To depress the head, when passing on the top of a coach under a low arch, is just as instinctive: and the action of any muscle may be so willed, or any combination of muscles.

Secondly as to our being forced to inspire. If you cause strong pain or titillation in a person, he will be compelled, whatever restraint he may attempt upon himself, to cry out or laugh, and to make an effort to remove it by motion of some part, quite as forcibly as he is compelled to remove the uneasiness in the chest by inspiration; and while history records innumerable examples of persons, whether Christians or heathens, so resolute as to remain motionless and silent, by the force of their faith or innocence or their contempt for their persecutors[d], in the midst of fire till they were consumed, and we ourselves know the resolution of Hindoo widows every day to perish on the funeral pile of their husbands, we read of suicides so determined as to have accomplished their purpose by merely holding their breath, when deprived of access to instruments of destruction.[e] Thus, though some have regarded the muscles of

[d] See Lord Bacon, *De Augmentis Scientiarum*, l. iv. cap. 1. Among other instances of resolution he mentions that, in his day, a murderer of Burgundy, "when beaten with iron rods and torn with red-hot pincers, did not utter a groan, and, seeing something break and fall accidentally on the head of a bystander, the rascal laughed in the midst of his torments while being burnt, though he had just before cried at having his curly hair cut off."

[e] "Servus barbarus, cum vehementi irâ concitatus, mortem sibi consciscere decrevisset, prostratus humi, respirationeque cohibitâ, longo tempore immobilis erat; postea verò paululum volutatus, hoc pacto mortuus est." (Galen, *De Nat. Musc.* lib. ii. c. 6.)

A robber named Coma, when taken before the consul Rupilius, is said by

respiration as of a mixed character, as both voluntary and involuntary, they appear to me as voluntary as any voluntary muscles; but equally, though not more, liable to become involuntary. The orbicularis palpebrarum all allow to be a voluntary muscle; yet, if a person suddenly moves his finger towards one of our eyes, even without touching it, we wink involuntarily. Nay, without such motives, some voluntary muscles are in certain circumstances involuntary. We move our ring finger at pleasure; yet if we bend our little finger, few can refrain from bending the ring finger. We experience great difficulty "in attempting to move the hand and foot of the *same* side in *different* directions, and in all those motions which, although voluntary and perfectly easy if produced separately, are found very difficult if attempted together."[f] Again, "few voluntary motions may not be rendered involuntary by the force of habit, whose influence upon the mind is immense." Every action of the system, mental or corporeal, takes place more readily in proportion to its repetition; and therefore certain actions of voluntary muscles may at length occur not only with an almost imperceptible exciting cause, but in doing an action we may from habit be unable to perform it except in one way, and actions of

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Valerius Maximus to have so destroyed himself. "Let others," says the historian, "sharpen the sword, mix the poison, take the rope, look for precipices,"— "nihil horum Coma, sed intra pectus inclusa anima, finem sui reperit." (Lib. ix. cap. xii. externa. 1.)

Few can have so much determination; and, indeed, success can rarely follow this attempt at suicide, because, as soon as the brain begins to suffer, the effort must decline, and the effects cease. Still, from general or partial tenuity of the vessels of the head, such congestion may readily occur as may occasion rupture; and suicide of this kind is therefore by no means impossible. I have known the sinuses rupture under strong muscular exertions.

Dr. Georget mentions that a M. Bourdon made some experiments upon himself, from which it appeared that a person may commit this kind of suicide. (*De la Physiologie du Système Nerveux, &c.*, t. i. p. 387.)

It is said that suicide has frequently been committed by turning the tongue back, and thus excluding the air from the larynx. In *Notices of Brazil, in* 1828–9, the Rev. R. Walsh says that the poor wretched slaves often destroy themselves thus. "A friend of mine," he adds, "was passing when a slave was tied up and flogged; after a few lashes he hung his head, appearing lifeless, and when taken down, was actually dead; his tongue was found wedged in the œsophagus.

[f] "Consult Winslow, *Mém. de l'Acad. des Sciences de Paris*. 1739."

voluntary muscles in which we have indulged may be performed against our wishes in particular circumstances.

Between the portion of the brain that wills and the muscle, an intermediate portion of the nervous system exists. The will is not exerted upon the muscles, but upon the motor nerves of muscles at their extremity in the brain or spinal chord. Now this extremity or the nerve in any part of its course may be stimulated by other causes than the will, and thus the muscles ordinarily stimulated by the will may be stimulated without it, —the will may neither voluntarily nor involuntarily have a share in stimulating the muscles. Thus it is in chorea [g], tetanus, and other spasmodic diseases of the voluntary muscles. Even in palsy of motion, we often observe spasms, especially in paraplegia. Now, when a motion is naturally willed in consequence of a sensation in a particular part, a peculiar relation exists between the nerves of sensation of that part and its nerves of motion, so that irritation of the former is communicated to the latter. Thus at page 420. we saw that in 1788 Sir Gilbert Blane found the hind legs of a decapitated kitten retract if the paws were touched with a hot wire, and the tail move if so touched after division of the chord below the last lumbar vertebra. In cold blooded animals similar observations had long before been made. Redi in 1687 [h] found in a large tortoise, which lived twenty-three days after losing its head, that the fore and hind feet were forcibly convulsed whenever they were pricked. Whytt, in 1745, found that, if the toes of both feet of a decapitated frog are stimulated, the feet are drawn up

[g] The exciting cause that influences the nervous system beyond the cerebral part which wills may be opposed, and temporarily with success, by the will; and on the other hand the will may aid the exciting cause. So that under chorea persons can frequently arrest the motions for a few seconds, or run when they cannot walk; and, again, they often seem to feel a pleasure in co-operating to produce the morbid movements.

[h] I mentioned, *suprà*, p. 421., that, above a century and a half ago, Duverney found a bird would move after losing its brain; Dr. Kaau, in 1745, observed a frog move all its limbs for half an hour after decapitation, and for a considerable time after its body was divided in two. A viper, after losing its head and bowels, moved towards a heap of stones where it had been accustomed to hide itself. (*Impetum faciens*, No. 331.) Redi extracted the brain of a land tortoise through a hole in the skull, and it lived from November to May, moving and walking about to the last. (*Osservazioni intorno agli animali viventi*, &c. Napoli. 1687. p. 209. sq. Butterflies copulate and lay eggs after decapitation.

to the body; or, if one foot only, that foot only is drawn up.[i] He also found that, if the muscles of the leg of a decapitated frog are irritated, almost all the muscles of the lower extremities move, provided the spinal chord is entire; but, if the chord is destroyed, the neighbouring muscles remain still, and the irritated muscle itself is only excited to a tremulous motion.[k] He also noticed that, though the muscles of the thighs were contracted when pricked or cut, neither they nor the neighbouring muscles were nearly so strongly convulsed as when the toes were wounded, — the toes having a much more acute sensibility.

Others have since variously illustrated these facts. Dr. Magendie mentions that, when the posterior roots of the inner side of the spinal nerves are irritated, the signs of extreme pain are accompanied by convulsions of the muscle of that same side only: Mr. Mayo, that, if the head of a pigeon is cut off and all the brain removed except the little to which the common motor nerve of the eye is attached, and the optic nerve divided and its truncated extremity connected with the brain pinched, the iris instantly contracts: Dr. Macartney, that, if the head of a pigeon is cut off, nay, if even the eye is taken out, light suddenly admitted to the retina produces contraction of the iris.

These facts have lately given rise to a speculation that a portion of the nervous system exists independent of will, and solely for involuntary actions of what are usually considered voluntary muscles, by means of impressions, not felt, on nerves usually considered nerves of sensation. A portion of the chorda oblongata and of the chorda spinalis is fancied to be separate and independent of the rest, and this imaginary part is called by its inventor,—Dr. Marshal Hall[l], *excito-motory*. This physician has made experiments fundamentally the same as those of Sir Gilbert Blane and his successors. Instead of separating a portion of the body with its corresponding portion of encephalo-spinal substance in which the nerves of sensation and motion meet, he only stupefied an animal. He struck a horse with a pole-axe over the anterior lobes of the brain. It fell as if thunderstruck; was convulsed, and then motionless. But it soon began to breathe, and continued to breathe freely. When

[i] *Observations on Irritability*, sect iv. p. 4. [k] Ibid.
[l] *Phil. Trans.* 1833. P. ii.; and *Lectures on the Nervous System.* 1836.

lacerated or pricked by a pin or nail on any part of the face or rest of the surface, it was still motionless, and gave no evidence of impression. But on touching the eyelash with a straw, the eye forcibly closed; on touching the cornea, the eye rolled outwards; and on touching the verge of the anus, the sphincter contracted, the tail was raised, and the vulva drawn towards the anus. Now this only shows what is well known, that tickling certain exquisitely sensible parts with a straw induces a stronger impression than rough usage with a nail or pin. A person who could bear pain without flinching, could not remain still under tickling of certain parts: and yet it is only certain parts that are so ticklish. The sensible ends of the fingers or the back of the hand may be touched with a straw in vain. Dr. M. Hall himself shows that a strong impression made any where would equally excite motion. For he goes on to repeat the very experiment of Sir Gilbert Blane. He divided the spinal chord of a frog below the occiput. The animal was still. He *pinched*, not tickled, a toe with a pair of forceps. Both hind extremities moved. He pinched again, and the motions recurred. Now this was not an eyelash, the cornea, or verge of the anus, but some other part of the surface, and it might of course have been any sensible part, and the corresponding muscles of the part would have acted. If a correspondently strong impression had been made in the horse, motion would have equally taken place. Surely, when we wink on the eyelash being touched, we do this by precisely the same operation as when we withdraw a hand that is struck. Of course, when the spinal chord is destroyed, or any portion of the encephalon is destroyed in which are the extremities of the nerves of sensation that convey the impression, or the extremities of the nerves of motion that convey the stimulus to the muscles, or in which they meet, as they probably do, no effect from pricking or tickling, &c. can ensue. Dr. M. Hall considers that the excitor nerves of the excito-motory system are the ganglionic portion of the fifth and of each spinal nerve, and the pneumono-gastric; the motor nerves of it, the aganglionic portion of the fifth and of each of the spinal nerves; the fourth, sixth, seventh, and ninth encephalic, the pneumono-gastric and its pharyngeal and laryngeal branches, the spinal accessory, the phrenic, and Sir C. Bell's external respiratory.

Now really the whole truth appears to be what is well known,

that an impression made upon *any* nerve of sensation, or, what is the same thing, upon *any* part endowed with sensibility, may induce action of *any* voluntary muscles calculated to remove it, if disagreeable, or to be useful in some way to the individual, even though the brain be prevented from perceiving the impression, —from having a sensation from the impression. The impression need not be upon nerves running to the part of the encephalo-spinal organs where the roots lie of the motor nerves excited, for a sharp pinch of the toe will make a man not merely draw away his foot, but raise his arms, make a face and halloa into the bargain, whether he is asleep or awake. Tickling the sentient twigs of the fifth pair, the eyelid, and cornea, is not requisite to cause winking; if by the optic nerve, one not included in Dr. M. Hall's excito-motory class, we see a finger suddenly approach the eye, instinctive, involuntary winking will as certainly occur. Winking will occur if a strong light is suddenly admitted through the lids to the *retina* of a person asleep. The sun's glare upon the retina will excite sneezing.[m] Not only are sneezing, vomiting, sobbing, mentioned as acts of this system, but even deglutition, which is declared *always* to be of this nature, and always to require the presence of some stimulus to the sensible nerves of the pharynx, it being "impossible to perform the act of swallowing three or four times in rapid succession, without taking something into the mouth." Now if deglutition is always an *excited* act,—to use this gentleman's peculiar language,—is always produced involuntarily by an impression on the pharynx, it must be as impossible once or twice, without taking something into the mouth, as three or four times, and slowly as rapidly. I, however, can swallow with nothing in my mouth in rapid succession, as readily as with something, and above fifty times: that to say, till the muscles are fatigued. If swallowing is instinctive when any thing reaches the pharynx, so is the act of opening the mouth when a sugar-plum is offered to the eyes of a baby: and

[m] Just as Dr. Fletcher considered the respiratory function of Sir C. Bell's imaginary respiratory system of nerves, as only a part of its functions, its destination being for sympathy at large, as well as for the sympathetic respiratory movements, Dr. M. Hall considers Sir C. Bell's respiratory system of nerves as only a part of his own peculiar excito-motory system, which presides over respiration as well as other excito-motory functions. The views of all these gentlemen appear to me equally confined and erroneous.

indeed the various movements of the extremities, head, and trunk, which naturally are performed on various circumstances presenting themselves, are just as instinctive; and we have only to observe the movements of other animals, especially of those most like ourselves, and above all of monkeys, to see how instinctive our voluntary actions are, when we are most apt to regard them as determined by our reflection. We contract all voluntary muscles either simply because we think proper, as when we cough at the request of another, or because a strong motive is given, as when we withdraw the hand from any thing hot; and the latter is only such an instance as swallowing, coughing, winking, &c. when food is in the pharynx, phlegm in the larynx, or strong light in the eyes. Certain sensations excite a certain desire, and this may be too strong for us to overcome. But according to the strength of mind will be the resistance to the strength of the desire induced by the sensation. Some actions result from certain sensations only, and we can neither perform some without these sensations, nor when these sensations exist find it possible not to yield to the desire. With some deglutition is not an act of this kind. But sneezing is with all. I never knew a person able to sneeze at pleasure. To be induced to will sneezing we must have a certain sensation. If our attention is drawn to something else, though the irritating cause act, we do not feel the sensation, and do not sneeze. If the sensation is felt forcibly, the impulse may be too strong for us to resist, and sneezing will be involuntary: and we can bring ourselves to sneeze by attending closely to the sensation, and by increasing it. I have often amused myself by looking more or less at the sun, or thinking more or less of tickling felt at the moment in the nostrils, and so increasing and lessening the inclination to sneeze. Without the *sensation*, and a certain amount of it, the sneezing no more than venereal convulsion of the ejaculatores takes place. At the same time, the facts discovered by Sir Gilbert Blane and others show a connection between motion and impression independent of the brain. But this is probably intended to assist the will in exciting motions on the occurrence of impressions on individual parts; and the impression may be so strong that the will may be compelled to determine the motion, and this compulsion will be according to the strength of the impression and the weakness of opposing motives and of the resolution to resist the inclination. Nay, these

facts show that motion will occur when the brain is removed and there can be no sensation. Yet when the brain exists and in healthy force, that the will does co-operate with this local excitement of nerves of voluntary motion by those of sensation, when we might not be disposed to believe it, appears from the curious facts mentioned at pages 486–491. showing that sensations may occur, and the will may be exercised, almost unconsciously. While the brain exists and the system is in health, these motions do not occur without will, or without sensation should the will be overpowered.

Involuntary muscles have generally a faint red colour, tolerable firmness, fibres small and rather interwoven together, blood-vessels and nerves comparatively numerous and small, and seldom a tendon: while voluntary muscles have generally a deep colour, comparatively soft consistence, their apparent fibres large and generally parallel, comparatively few and large blood-vessels and nerves, and commonly a tendon.[n]

Involuntary muscles are said not to contract suddenly on division, and to perform not one sudden but several contractions, when stimulated; whereas voluntary muscles, when divided or stimulated, contract suddenly.

Involuntary muscles are said to have more nerves proportionately than the voluntary.

Like all other parts, muscles require a supply of arterial blood; and this is proportionate not only to the bulk of a muscle, but to the force and duration of its action. If venous blood is sent to the brain, we have seen that death ensues, and the function of any part is arrested by forcing venous blood into its arteries[o]: this not only not supplying the place of arterial blood, but acting as a poison. Muscles, however, retain their excitability after their supply of arterial blood is cut off, as when they are separated from the body. "In the Stenomian[p] experiment, paralysis of the hind legs commonly follows the application of a ligature upon the abdominal aorta." But this does not show the excitability of the muscles to be impaired; they would doubtless contract immediately after the experiment, upon the appli-

[n] Dr. Fletcher, l. c. P. 1. p. 109.

[o] Bichat, *Recherches Physiologiques.*

[p] "Steno. *Elementar. Myologiæ Spec.* Florent. 1667. 4to. p. 86."

cation of a stimulus, as readily as they do after apoplexy, and after removal of the brain or division of their nerves. In torpid brutes, after division of the nerves and removal of the brain, cold and warmth destroy and restore the excitability of muscles, as usual. The ligatures act immediately by depriving the nerves of the power of stimulating them; for a constant supply of arterial blood is necessary to the functions of the nervous system[q], and the ligature of the abdominal aorta, repeated by Courten and Haller[r], cuts off this from the lower part of the spinal chord and what originate from it, — the nerves of the hind legs.[s] Another source of loss of motion must ultimately arise, — the loss of excitability and vitality from the want of circulation in the muscle.

In regard to its composition, muscle is said to be essentially fibrine, but to contain also albumen, gelatine, lactic acid, fat, salts, &c. and a substance termed osmazome, upon which the peculiar taste and smell of soup depends, and which is a yellowish brown substance, soluble in water and in alcohol hot or cold, and not forming a jelly when concentrated.

Raspail properly points out that muscle has thus been analysed on the large scale, with its blood-vessels, lymphatics, nerves, and fatty cellular membrane; but that the analysis should have been limited to the muscular cylinder. Gelatine is produced from cellular texture, skin, tendons, ligaments, cartilages, and bones by boiling only: osmazome by boiling from muscle, serum, and mushrooms, and, according to him, is only an impure compound of albumen and acetic acid: lactic acid he declares to be merely acetic acid and albumen: and leucine, a white matter obtained from muscle by Braconnot through the means of sulphuric acid, to be only a mixture of oil, and even albumen rendered soluble by an acid, with sulphite of ammonia. By repeatedly boiling muscle, and holding it in the air between each boiling, Berthollet found it at last acquire the smell and taste of old cheese. The

[q] Le Gallois, *Sur le Principe de la Vie.*

[r] "W. Courten, *Phil. Trans.* No. 335. p. 500." 1678.

"Haller, *Comment. Soc. Sc. Gotting.* t. iv. p. 293." 1754.

[s] Sir Astley Cooper has just published the result of obstructing the vertebral arteries which supply those parts of the spinal chord from which the nerves chiefly concerned in respiration arise. Dyspnœa instantly ensued. (*Guy's Hospital Reports,* No. iii.)

same are perceptible in dried anatomical preparations; and Raspail by repeated boiling effected them in fecula, converting it into caseic acid. If fresh muscle is exposed for some time to water, or kept in moist earth, the fibrine disappears, and a white fatty matter remains called adipocire: but this is usually ascribed to a change of the fat in the muscle. Muscle may perhaps be changed during life into fat, for we possess in University College diseased muscles, in which each fibre is replaced by a string of fat. Fibrine abounds most in the muscles of the old.

Besides the vital movements which probably occur in the vessels and cellular texture of plants, and those which occur slowly in the stalks and tendrils of annuals which cling, and in leaves, we observe the flowers and leaves of many plants stand up open in the day and fall or close at night. On the approach of a storm, the leaves of most plants with delicate stamina become erect, so that white flowered meadow trefoil is a barometer to the Swedes. Artificial light will make the flowers and leaves of some plants expand at night, and removal to a dark place in the day time make them droop; while the approach of hot iron to their upper surface will make some leaves erect. Cold and narcotics lessen or destroy, while all stimuli augment, these movements, which are more vigorous in the young than in the old. Even mechanical irritation, perhaps a mere touch, will cause motions in the leaves of mimosæ; and the motion will spread from the one irritated to other leaves successively, and the petiole, and at last the foot-stalk itself, descends. The lobes of the leaves of the dionæa muscipula have stiff hairs on their edge, and close instantly upon a hapless insect which lights upon them; and, as each lobe of the leaf has three thorns, the poor thing is not only imprisoned but impaled on the spot: and, what is still more cruel and corresponds in design with the craftiness of animals, as that does with their destructiveness, the leaf is supplied with glands which secrete sugar and thus tempt the instinct of the poor thing. The small lateral leaves of the hedysarum gyrans and cuspidatum are in incessant motion. Some flowers contract on mechanical irritation. The stamina and pistils of flowers, but especially the stamina, perform many varieties of motion, and also obey external stimuli, and are influenced by poisons.*

The voluntary motions are the distinguishing characteristics of the animal from the vegetable kingdom. For no plant has been discovered procuring for itself food by means of voluntary motion; nor any animal incapable of locomotion, or at least of procuring sustenance by the voluntary motion of individual members.

Muscles exist in animals of all classes, from the mammifera to the radiaria.

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* Consult Dr. Tiedemann, l. c. ccccIxxiii. sqq.

They have been discovered in agreat number of entozoa. Even in the actiniæ, some medusæ, and other zoophyta, muscular fasciculi, interwoven with the external skin, have been perceived; and Professor Ehrenberg has detected them in the infusoria.* Their fibres are not always red, but may be white, or yellowish.

Minute and numerous hair-like processes, called *cilia*, are observed on the external surface of batrachian larvæ, of mollusca, annelida, echinodermata, actiniæ, medusæ, polypi, and infusoria; on the surface of the air passages of man and other mammalia, birds and reptiles, as well as on the external gills of batrachian larvæ, and on the gills of mollusca and annelida; in other annelida, and in echinodermata and actiniæ, on the membrane of the external surface of the viscera and its parietal portion to which water has access; on the surface of the mouth and gullet of reptiles, and more or less on the whole of the rest of the alimentary canal of mollusca, actiniæ, annelida, echinodermata, and polypi; in the pores and canals of sponges; on the mucous membrane of the Fallopian tubes, uterus and vagina of mammalia and fish, as well as on the organ of smell in the latter, and the oviduct of birds and reptiles; on the surface of the embryo of batrachia, mollusca, actiniæ, polypi, and sponges. The longest cilia hitherto measured have proved ·005 of an inch, the smallest ·000075 of an inch. The motion of each cilium is commonly of a fanning character, though sometimes it is rotatory, or, as the point revolves the most extensively, infundibuli-form; and separation of the part, and even death, does not arrest it for a few hours in mammalia and birds, nor for upwards of a fortnight in the tortoise and river mussel, — differences corresponding with the varied duration of muscular contractility in the same animals. The purpose of this vibration is to carry the animal through the fluid in which it lives, or to drive fluids along its surfaces. For a full account of the cilia, see a paper by my no less excellent than able colleague Dr. Sharpey, in Dr. Todd's Cyclopædia of *Anatomy and Physiology* Very recently Purkinje has discovered them on the linings of the cerebral cavities of the fœtuses of some mammalia. Müller's *Archiv für Anatomie, Physiologie,* &c. No. 1. 1836. p. 291. sq.

Sometimes, as in crustacea and insects, they are situated in hollow, calcareous or horny parts; sometimes in earthy shells, as in bivalve and multivalve mollusca.

A writer says that he "repeatedly placed a common dorr," the occupation of which beetle is to heave up the earth, "under a weight equal to 4796 grains, 319 times its own weight," the animal being but 15 grains, and the creature "heaved it up and withdrew; and the same pressure, being placed on its leg, was immediately disengaged by the power of the other." (*Journal of a Naturalist*, p. 305.)

Muscular power is no where more displayed than in some fish. "I have seen," says Sir Gilbert Blane, "the sword of a swordfish sticking in a plank

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* See Dr. Gardiner's account of Professor Ehrenberg's discoveries in the *Edin. New Phil. Journ.* 1831.

which it had penetrated from side to side; and when it is considered that the animal was then moving through a medium even a thousand times more dense than that through which a bird cleaves its course at different heights of the atmosphere, and that this was performed in the same direction with the ship, what a conception do we form of this display of muscular power!" (*On Muscular Motion. Select Dissertations*, p. 281.) Muscular strength is proportionally much greater in smaller animals. "A flea can draw from seventy to eighty times its own weight, whereas a horse cannot draw with ease more than three times its own weight." (l. c. Haller, *El. Physiol.* L. ix. S. iii.)

A flea weighs less than a grain, and will clear an inch and a half at a leap; and Americans have calculated that if a man, weighing about 150 pounds, could leap in proportion, he would be able to spring 12,800 miles, and so jump with ease from New York to Cochin China.

In some animals of very slow motion, as the tardipedes, the chief artery of the extremities is found split into many parallel trunks, instead of remaining as one and branching forth. (Sir Anthony Carlisle, *Phil. Trans.* 1810.) In the fore leg of the lemur tardigradus, sixty brachial arteries exist. The connection between this circumstance and slow motion is unknown.

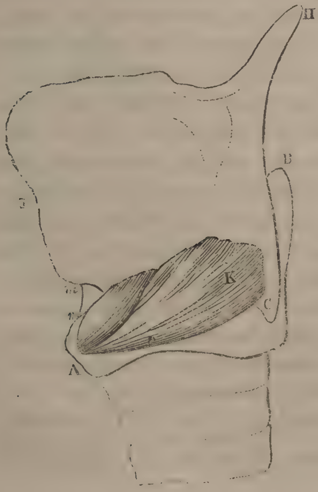
CHAP. XXI.

VOICE AND SPEECH.

An important operation of muscular motion is in producing sounds by means of those parts through which the air passes in respiration.

The vocal mechanism may be considered as consisting of lungs, or bellows, capable of transmitting, by means of the connecting windpipe, or trachea, a current of air passing through an apparatus called the larynx, which is placed on the upper part of the windpipe. This apparatus, though of very small dimensions, is capable of producing sounds in great variation of pitch, quality, and intensity, which are afterwards converted into the articulations of speech by passing through a cavity consisting of the pharynx, mouth, and nose.

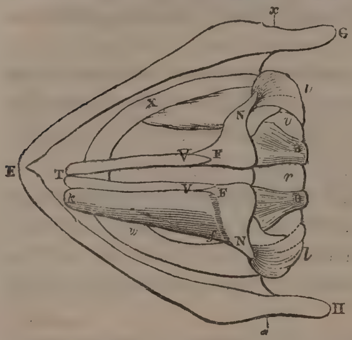
The larynx is the organ of voice. It consists of several cartilages united together by ligaments and articulations, and supplied with a variety of muscles, by which they may be moved together or separately, according to the modifications of the voice.



E *m* C H, the thyroid cartilage;
H, its upper horn;
C, its lower horn, articulated to the cricoid;
A *n* B C, the cricoid cartilage;
A K, the crico-thyroideus muscle.

Above the pile of cartilaginous rings which compose the windpipe is placed the cricoid cartilage; the thyroid cartilage embraces the cricoid, and is articulated to its sides so that its lower horn turns round on a point as a fulcrum. Two small cartilages called the arytenoids are articulated to the upper external edge of the cricoid, and the vocal ligaments are stretched from the thyroid to the arytenoids. The aperture between the edges

Bird's-eye view of the larynx from above.



G E H, thyroid cartilage, embracing the ring of the cricoid *r u* X *w*, and capable of turning on the axis *x z*, which passes through the lower horns C, seen in the preceeding figure;
N F, N F, the arytenoid cartilages;
T V, T V, the vocal ligaments.
From N to X run the right lateral crico-arytenoid muscle, the left having been removed.

of the vocal ligaments is called the glottis; and in all the theories which have been advanced it has been admitted that the vocal sound is produced by the breath passing through this aperture, though different explanations have been offered of the way in which the voice is produced. Ferrein compared the vocal ligaments to violin strings, and the current of air which puts them in motion to a violin bow; the different sounds he attributed to various tensions of the ligaments. Dodart found an analogy between the glottis and the embouchure of a flute; the pitch of the sound he supposed to depend on the size of the aperture. Biot thought the way in which the sound of the voice was produced more analogous to a reed, and particularly to that kind of reed which has but lately been introduced into a variety of musical instruments. Savart has lately endeavoured to prove that the sounds of the voice are produced in the same manner as in a lark-whistle, and that the pitch depends on altering the tension of the elastic sides of the small conical tube formed by the part of the larynx immediately before this aperture.

There can be no doubt as to the way in which the sonorous vibrations are produced in the larynx. If a piece of silk riband,

or a strip of paper, parchment, or any other flexible substance, be stretched between the fingers or otherwise, and a current of air either from the mouth or a bellows be directed against one of its edges, a clear musical sound will be produced, varying in pitch according to the tension given it; and, if a riband of thin Indian rubber be employed, the sound will very much resemble that of the voice, and be capable of an extensive range by varying the tension. The itinerant exhibiters of Punch employ a silk riband stretched between two arched pieces of tin, and, placing this between the tongue and the palate, they without sounding the voice pronounce all the articulations of speech by whispering, and imitate the various inflexions of the voice by pressing more or less on the thin sides, thus increasing or diminishing the tension of the riband. Dr. Darwin was the first who appears to have recognised the resemblance of this instrument to the ligaments of the glottis.

The vibrations of an elastic ligament set in motion by the air being thus sufficient to account for the production of the voice, we have only to examine the particular disposition of these ligaments in the larynx, and the precise way in which the air acts upon them. Each vocal ligament, stretched between the arytenoid and the thyroid, presents a sharp edge turned upwards and inwards. Mr. Willis of Cambridge [a] has shown that, if a current of air be made to pass between two stretched surfaces, they will vibrate only when their free edges are parallel;—if they be turned either outwards or inwards, the air will pass without producing any sound. He hence infers that a certain position of the edges of the ligaments is necessary for the air issuing from the lungs to cause them to sound, and this vocalising position is determined by the twisting motion of the arytenoid cartilages.

" That every degree of motion in the glottis is directed by the numerous muscles of the larynx is proved by the beautiful experiment of tying or dividing the recurrent nerves, or the pneumonogastric [b], and thus weakening or destroying the voice of animals."

[a] Of the Mechanism of the Larynx. *Camb. Phil. Trans.* 1832.

[b] " Respecting this celebrated experiment, anciently made by Galen, consult among others W. Courten, *Philos. Trans.* No. 335.

Morgagni, *Ep. Anatom.* xii. No. 20. P. P. Molinelli, *Comment. Institut. Bonon.* t. iii.

J. Haighton, *Memoirs of the Medical Society of London*, t. iii."

But for the operation of the nerves I refer to my former observations on the pneumono-gastric nerve at page 433.

" Man and singing-birds have the power of *whistling*. In the latter, it is accomplished by a larynx placed at each extremity of the windpipe and divided into two portions. The former, though possessing a single and undivided larynx, has probably learned to imitate birds by the coarctation of his lips[c]," which, however, serves only as an embouchure to the column of air contained within the mouth and larynx. The varieties of intonation entirely depend on the alterations of the tongue and on the corresponding motions of the larynx. For the higher sounds the tongue is brought forwards and the larynx raised, and for the lower sounds the tongue recedes and the larynx is depressed.

" *Singing*, which is compounded of speech and a musical modulation of the voice, I conceive to be peculiar to man and the chief prerogative of his vocal organs. The power of whistling is innate in birds; many of them may easily be taught to pronounce words, and instances have been known of this even in dogs. But it is recorded that genuine singing has once or twice only, and then indeed but indifferently and with the utmost difficulty, been taught to parrots; while, on the other hand, scarcely a barbarous nation exists in which singing is not common.[d]

" *Speech* is a peculiar modification of the voice, adjusted to the formation of the sounds of letters by the expiration of air through the mouth or nostrils, and in a great measure by the assistance of the tongue, applied and struck against the neighbouring parts, the palate and front teeth in particular, and by the diversified action of the lips.[e]

[c] " The larynx, even among the most savage people, is capable of imitating the sounds of brutes. Consult, v. c. Nic. Witsen, *Noord en Oost — Tartarye*, ed. 2. Amst. 1705. vol. i. p. 165., respecting the inhabitants of New Guinea of the southern hemisphere, called *Papus*. And J. Adair, *History of the American Indians*, p. 309., respecting the Choktah tribe of North America."

[d] " I have in my hands the testimony of most respectable travellers, in regard, for instance, to the inhabitants of Ethiopia, Greenland, Canada, California, Kamtschatka, &c., and therefore wonder at the assertion of Rousseau, — that singing is not natural to man. *Dictionn. de Musique*, t. i. p. 170. Geneva, 1781. 12mo."

[e] " See Rich. Payne Knight, *Analytical Essay on the Greek Alphabet*. Lond. 1791. 4to. p. 3."

"The difference between voice and speech is evident. The former is produced in the larynx; the latter by the peculiar mechanism of the other organs above described.

"Voice is common to both brutes and man, even immediately after birth, nor is it absent in those unfortunate infants who are born deaf. But speech follows only the culture and employment of reason, and is consequently, like it, the privilege of man in distinction to the rest of animal nature. For brutes, natural instinct is sufficient [f]: but man, destitute of this and other means of

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I am indebted to the powerful Dr. Conyers Middleton for the knowledge of two cases of distinct articulation with at least but little tongue. (*An Enquiry into the Miraculous Powers, &c.* Miscellaneous Works, vol. i. p. 148. 4to.) In his exposure of the *pious* deceptions of weak and wicked Christians during the first centuries of the Christian era, he notices a pretty tale of an Arian prince cutting out the tongues of some of the orthodox party and these being as able to talk as before; nay one (*O hominum impudentia!*), who had been dumb from his birth, gained the faculty of speech by losing his tongue. Granting the fact, and even that the tongues were completely extirpated, he refers, for the purpose of proving there was no miracle in the case, to two relations of similar instances by medical men. (Jussieu, *On Speech without a Tongue. Mém. de l'Acad. des Sciences.* 1718. p. 6.) Professor John Thomson found the speech little impaired after bullets had carried away more or less of the tongue. (*Report of Observations made in the British Hospitals in Belgium, after the Battle of Waterloo; with some Remarks on Amputation.*) Louis, Richter, Huxham, Bartholin, and Tulpius mention similar cases. An instance of good articulation after the loss of the apex and body of the tongue quite down to the os hyoides occurred in this country, and was seen by the Royal Society. (*Account of a Woman who spoke fluently without a Vestige of Tongue. Phil. Trans.* 1742. p. 143. Dr. Parson's *Account of Margaret Cutting, who had lost her Tongue. Phil. Trans.* 1747. p. 621.

[f] Mr. Herbert, in a note to White's *Natural History of Selborne*, p. 227. says he saw Col. O'Kelly's green parrot, about 1799, which sang, perfectly, about fifty different tunes, solemn psalms, and humorous or low ballads, articulating every word as distinctly as a man, without a single mistake, beating time with its foot, turning round upon the perch, and marking the time as it turned; if a person sang part of a song, it would take it up where he left off; and, when moulting and unwilling to sing, turned its back and said, "Poll's sick." The dog to which Blumenbach alludes was seen and heard by Leibnitz (*Op.* vol. ii. p. 180. ii.), who declares it pronounced all the letters of the alphabet except m, n, x, and thirty German words; was three years old when it went to school, and required some years for finishing its education. Locke, however, goes farther than Leibnitz, for he relates a story in his *Essay on Human*

supporting his existence independently, enjoys the prerogative of reason and language; and following, by their means, his social destination, is enabled to form, as it were, and manifest his ideas, and to communicate his wants to others, by the organs of speech."

The elements of which all the spoken languages of mankind are composed consist of the modifications given sometimes to the breath, and at other times to the voice, during their passage through the cavity of the mouth; these modifications are principally effected by the altered positions of the lips and tongue with respect to the fixed parts of the containing cavity.

The classification of these articulations into vowels and consonants has been generally recognised.

The *vowels* are formed by the voice, modified, but not interrupted, by the varied positions of the tongue and lips. Their differences depend on the various proportions between the aperture of the lips and the internal cavity of the mouth, alterable by the different elevations of the tongue. The vowel *aw* (as pronounced long in *a*ll, and short in g*o*t) is formed by augmenting the internal cavity by the greatest possible depression of the dorsum of the tongue, and, at the same time, enlarging the separation of the lips. Departing from this sound there are two series. In one the external aperture remains open, and the internal cavity gradually diminishes by the successive alterations of the tongue; in the other the positions of the tongue are successively the same as in the first series, but the aperture of the lips is diminished. The approximation of the lips produces a more sensible effect as the inner cavity is more enlarged; hence two modifications of the first sounds of the second series are easily recognised, whilst only one variety of the others is readily appreciable, as will be shown in the following table.[g] Each of these vowels may be long or short, according to the duration of its sound in a syllable.

Understanding, (book ii. p. 27.) on the authority of Prince Maurice, and believes it too, of an old parrot that held a rational conversation.

[g] For the more open sounds, the jaws are generally more separated; but this is not indispensable.

TABLE OF VOWELS.

First Series. — The lips fully open.			Second Series. — The lips partially open.			Third Series. — The lips nearly closed.		
	As pronounced			As pronounced			As pronounced	
	Long, in	Short, in		Long, in	Short		Long, in	Short, in
1. *aw*	*caught*, *fall*	*folly*	6. *o*	*coat*	Not used.	11. *oo*	*cool*	*full*
2. *ah*	*father*, *car*	*dull*	7. *o*	*court*				
3. *ae*	*nae* (Scotch)	*man*	8. *eu*	*bonheur* (Fr.)				
4. *a*	*fair*[h]	*met*	9. *eu*	*affreux* (Fr.)				
5. *e*	*feet*, *the*	*fit*	10.	Expressed in German by *ü*, in Danish and Swedish by *i*, in Dutch and French by *u*.				

The above table exhibits all the most usually pronounced vowel sounds, but practised ears might distinguish others intermediate in each series. When these vowels are sounded, the soft palate is raised so as to prevent the voice from issuing through the nasal channels; when, on the contrary, the soft palate is depressed, the partial escape of the breath through the nostrils modifies all the preceding sounds in a very evident manner. To distinguish these two modes of articulating the vowel sounds, we may adopt Dr. Darwin's terms, orisonant and narisonant vowels.

Consonants may be divided into continuous (sometimes called liquids or semi-vowels) and explosive. For the latter, the breath or voice is stopped in its passage through the mouth; for the former, it is allowed a free passage, though the apertures are more narrowed than for the vowels.

But the most comprehensive and important division of these articulations is into aspirates and sonants; the modifications of the breath being meant by the former term, and those of the voice by the latter. In ordinary speaking these are mingled together to form the elementary syllables of language. The aspirates, or sounds indicated by the characters *p*, *f*, *sh*, *s*, *th* (in *th*ing), *t*, *k*, *ll* (Welsh), differ from the sonants, or those represented by

[h] This vowel is much used by the Irish in pronouncing such syllables as *bate fait*, &c., for our English words beat, faith, &c.

b, *v*, *z* (in azure,) *z* (in puzzle), *th*, (in *th*e), *d*, *g* (in gay), *l*; only by the latter being accompanied with the vocal sound.

Every sonant has its corresponding aspirate, though many of the latter are unknown to the English language ; such are the aspirates corresponding to the sonants *r*, *m*, *n*, *ng* (in so*ng*), &c.

When forming the component parts of syllables, the aspirates, as well as the sonants, are always articulated with sonant vowels. An aspirate vowel, followed by its vocal enunciation, is always represented by the character *h*, but it is never pronounced separately, except in whispering.

The consonants, like the vowels, are divided into orisonant and narisonant. The only narisonant consonants in our language, are those corresponding to the orisonant explosives *b*, *d*, and *g* (in gay), — viz. *m*, *n*, and *ng* (in so*ng*). By this mode of pronunciation the sounds are rendered continuous.

TABLE OF CONSONANTS.

Continuous.			Explosive.			
	Aspirates.	Sonants.		Aspirates.	Orisonants.	Narisonants.
1.	*f*	*v*	10.	*p*	*b*	*m*
2.	—	*y*	11.	*t*	*d*	*n*
3.	*sh*	*z* & *j* in azure.	12.	*k*	*g* in gold.	*ng* in so*ng*.
4.	*s*	*z* in zany.				
5.	*th* in *th*ink	*th* in *th*e				
6.	(not used)	*r*				
7.	*ll*	*l*				
8.	—	*l* in fi*ll*e (Fr.)				
9.	*ch* in lo*ch* (Scotch) na*ch* (Ger.)	*g* in sagen (German) gemis (Sp.)				

This table shows that, for all the consonants employed in the English language, only ten positions of the mouth are required, the modifications being effected by other means. Among the modifications not already described, may be particularised the reduplication of the 10th, 11th, and 12th sounds; the first occasioned by the vibratory motion of the lips, the others by that of the tongue.

Observations. Sound, 1.—The lower lip presses on the upper teeth, but allows the air to escape between them; a similar sound is produced by allowing the breath to pass through the lips when nearly closed. 2, 3, 4, 5.—These sounds may be considered as the continuation of the first series of vowel sounds; for, by placing the mouth in the position for *e* (5.), and continuing to elevate the back part of the tongue, and, at the same time, to curl its tip, these sounds will be successively produced. 6, 7, 8.—These sounds differ from the preceding four, inasmuch as that the *back part* of the tongue does not approximate to the palate; the mouth being placed for the second vowel, the front of the tongue is elevated so as to touch the palate just above the teeth; for the *r*, the point is drawn back, so as to allow the air to escape; and for the *l*, the point is firmly pressed against the palate, and the breath escapes by the two sides; for the *l* (in fi*ll*e), the air escapes with more difficulty. 9.—These are used in the Gaelic and German, but not in English. 10, 11, 12.—These sounds are produced by the forcible escape of the breath, or voice, after a complete obstruction by the lips or tongue. The obstruction by the lips gives *p*, or *b*; that by the front of the tongue above the upper teeth, *t*, or *d*; and that by the back of the tongue against the palate, *k*, or *g*; these different articulations may therefore be distinguished as Labial, Dental, and Palatal. When the sound escapes through the nostrils it becomes continuous; the *m*, *n*, and *ng* are therefore not explosives.

The alphabetic characters, invented as visual and permanent representations of the articulations of speech, are very inadequate to effect the purpose intended. In the English language there are but five characters to indicate all the varieties of the vowels, viz. *a*, *e*, *i*, *o*, *u*. Of these, one only is pronounced, when uncombined, as a pure vowel; this is *e*, — the 5th sound in the table of vowels: the other four are diphthongs or combinations of two vowels; *a* is the 4th and 5th; *i* is the 3d and 5th; *o* is the 6th and 11th; and *u* is the 5th and 11th. When constituting parts of syllables, the same character represents many different vowel sounds.

The consonantal characters are not quite so arbitrary, though among these there are some simple sounds expressed by two letters, and others which have no character to denote them; and on the other hand there are several redundant letters representing

two simple sounds: *f*, *v*, *r*, *l*, *p*, *t*, *k*, *b*, *d*, *m*, and *n*, are generally constant in their signification. The simple sounds represented by two characters are *sh*, *th* (in *th*ink), *th* (in *th*e), and *ng* (in so*ng*). The single characters representing more than one sound are *s* (in *s*ea, hi*s*, *s*ure, and vi*s*ion); *z* (in *z*any and a*z*ure); *g* (in *g*ay and *G*eorge). The redundant letters are, *c* (having the sound either of *s* or *k*); *q* (*k* followed by the eleventh vowel); *j* (compounded of *d* and the second pronunciation of the *z*,—the same as the *g* in *G*eorge); and *x* (standing for *ks*, or *z*). Y, as generally pronounced, and *w*, are not consonants; the first represents the 5th, and the second the 11th vowel of the table, when immediately succeeded by another vowel.

The consonants will be best compared by articulating them all, uniformly preceded or followed by the same vowel; as *fe*, *she*, *se*, *the*, *pe*, *te*, *ke*, &c. or *ef*, *esh*, *es*, *eth*, *ep*, *et*, *ek*, &c.

It is by no means improbable that the progress of modern art may present us at some future time with mechanical substitutes for orators and preachers. For, putting aside the magic heads of Albert the Great and Roger Bacon, Kratzenstein actually constructed an instrument to produce the vowels [i], and De Kempelin has published a full account of his celebrated speaking machine which perfectly imitated the human voice. [k] The celebrated French mechanician, the Abbé Mical, also made two heads of brass which pronounced very distinctly entire phrases; these heads were colossal, and their voices were powerful and sonorous. The French government refusing, it is said, in 1782, to purchase these automata, the unfortunate and too sensitive inventor, in a paroxysm of despair, destroyed these masterpieces of scientific ingenuity. More recently, Mr. Willis of Cambridge has published a very interesting essay on the vowel sounds, in which he describes an instrument for producing them, and at the same time explaining their physical causes. My excellent and highly distinguished friend Professor Wheatstone, to whom the analysis of the elementary sounds I have above given is due, and whose valuable assistance in this section, as well as those on vision and hearing, I am proud to acknowledge, has also made many experiments illustrating the mechanism of speech, and succeeded in reconstructing and improving De Kempelin's machine.

[i] *Observations sur la Physique*, par Rosier, Supplement, 1782. p. 758.

[k] *Ueber den Mechanismus der Menschlichen Sprache.* Vienna, 1791.

As I have now fully explained the various articulations used in oral language, it only remains for me to investigate the difference between the inflexions of the voice in singing and in speaking.

The various muscular adaptations of the larynx render it capable of producing every inflexion of musical tone within a certain compass, seldom exceeding that of two octaves. In *singing*, sounds, each constant in its degree of tune, follow each other according to the rules of melody; while in *speaking*, the voice slides up and down, and "does not dwell distinctly, for any perceptible space of time, on any certain level or uniform tone, except the last tone on which the speaker ends or makes a pause." Provincial dialects, and even individual modes of speaking, differ much in the extent and nature of these slides. Steele has endeavoured to establish a system of notation for these inflexions, and other modifications of the voice necessary to be observed by the orator, and has by this means proposed to perpetuate the most splendid specimens of histrionic, forensic, and senatorial eloquence.[l] To proceed farther with this subject would be an infringement on the province of philology.

"We must just mention certain other modifications of the human voice, of which some, as hiccup and cough, belong more properly to pathology than to physiology, but are very common in the most healthy persons; and others, as crying and laughing, appear peculiar to the human race.

"Many of these are so closely allied as frequently to be converted into each other; most also are variously modified.

"In *laughter* there is a succession of short, and, as it were, abrupt expirations."[m] In it, there is more or less noise at each little expiration, from a mere sort of rustling sound to loud peals; the mouth is more or less lengthened, and its angles drawn up, and in extreme laughter it is opened still more by the descent of the lower jaw; if hearty, the tears run over, the head, and even the body, shakes, respiration is interrupted, and

[l] *Prosodia Rationalis; or, An Essay towards establishing the Melody and Measure of Speech, to be expressed and perpetuated by peculiar Symbols.* 2d. edit. London, 1779.

[m] "Fr. Lupichius, *De Risu.* Basil. 1738. 4to.
Traité des Causes Physiques et Morales du Rire. Amst. 1768. 8vo."

actual pain of the sides and diaphragm is felt.[n] Some of our comedians have absolutely agonised me. It arises from drollery, the anticipation of gratification, or actual gratification, or tickling; it is also common in hysteria and insanity. Smiling is the first degree of the same changes of the mouth.

"*Coughing* is a quick, violent, and sonorous expiration, following a deep inspiration."[o] In coughing, the mouth opens that the air may rush in that direction, since the current is not required in the nostrils as in sneezing, and these would not afford sufficient vent. The glottis lessens just before the expiration, and the transverse muscular fibres of the trachea lessen its diameter and thus increase the force with which the expelled air rushes.[p] Coughing is induced by the very slightest irritation of the larynx. But irritation of any part of the respiratory apparatus may occasion it, as well as irritation of a distant part influencing the respiratory apparatus sympathetically. It sometimes arises from a morbid sensibility of the nerves, so that I have known it occur for months at the full distension of *every* inspiration, except during sleep; and in other instances on the slightest touch of the outside of half the chest. There are many varieties of the sound and respiratory actions of cough.

"*Snoring* is" said by Blumenbach to be "a deep, sonorous, and, as it were, tremulous inspiration, from the vibration of the velum palati during deep sleep." We can, however, snore voluntarily while awake; and, by allowing a portion of the tongue to rise into contact with the velum, I can snore so that the sound shall proceed from vibrations of the nose as well as of the velum, evident both to the ear and to the fingers placed upon the nose. I can also increase the proportion of the nasal vibrations at pleasure, by allowing more of the tongue to rise into contact with the velum and palate, and cause them only to take place, even if the mouth is closed: and, if it is closed, snoring is always more or less nasal. In sleep, snoring may be palatal or nasal, or both in various proportions. The sound, as well as its situation, varies accordingly as it is palatal or nasal, or more one than the other.

[n] "Sport that wrinkled Care derides,
And Laughter holding both his sides."
L'Allegro.

[o] "J. Melch. Fr. Albrecht, (Præs. Hallero) *Experimenta in vivis animalibus circa tussis organa exploranda instituta.* Gotting. 1751. 4to."

[p] Sir C. Bell, *Phil. Trans.* 1832. p. 300. sqq.

" *Sneezing*, generally the consequence of an irritation of the mucous membrane of the nostrils," though the glare of the sun upon the eyes will produce it, "is a violent and almost convulsive expiration, preceded by a short and violent inspiration."[q] In sneezing, the opening of the fauces is lessened, and the head bent back, that the current may be directly through the nostrils, in which the irritation generally exists.

" *Hiccup*, on the contrary, is a sonorous, very short, and almost convulsive, inspiration, excited by an unusual irritation of" the stomach, and Blumenbach says only of " the cardia."[r] In hiccup, I think that, after the inspiration has proceeded a certain length, the glottis closes, and the diaphragm endeavours in vain to contract farther.

" In *crying* there are deep inspirations, quickly alternating with long and occasionally interrupted expirations.[s]

" *Sighing* is a long and deep inspiration, and the subsequent expiration is sometimes accompanied by *groaning*.[t]

" Nearest in relation to sighing is *gaping*[u], which is produced by a full, slow, and long, inspiration, followed by a similar expiration, the jaws at the same time being drawn asunder, so that the air rushes into the open fauces and the Eustachian tubes." We gape chiefly during fatigue or hunger; when we are but half awake, either before or after sleep; and in ague and hysteria. " It occurs from the blood passing through the lungs too slowly: *v. c.* when the pressure of the air on the body is diminished, as upon very high mountains." A peculiar feature of gaping is the propensity it excites in others to gape likewise. This is universally remarked. But the fact is included in the more general fact of gaping being excited by merely thinking of it, whatever be the means of association by which it enters into our thoughts, whether by seeing it represented in a picture, by reading of it, or having it mentioned to us. If this is the case, the view of others gaping may well be supposed sufficient to excite it.

[q] " Marc. Beat. L. J. Porta, *De Sternutatione*. Basil. 1755. 4to."

[r] " C. J. Sig. Thiel, *De Singultu*. Gotting. 1761. 4to."

[s] " J. F. Schreiber, *De Fletu*. L. B. 1728. 4to."

[t] " Dav. C. Em. Berdot, *De Suspirio*. Basil. 1756. 4to."

[u] " Just. Godofr. Günz, (Præside Walthero) *De Oscitatione*. Lips. 1738. 4to."

Dr. Brachet contends that the muscular power of the extreme bronchial twigs and air cells operates both in these violent and in the ordinary degrees of respiration. He divided the spinal chord in the neck of cats so that respiration ceased and was continued artificially. He then applied hellebore to their nostrils, and little expiratory shocks took place, very evident and necessarily independent of the respiratory muscles.[x]

Haller is well worth reading on these subjects.[y]

Most authors assert that the opening of the glottis enlarges at inspiration and lessens at expiration; but Dr. H. Ley makes it probable that, in simple and undisturbed breathing, the glottis remains open.[z] In strong muscular efforts the glottis closes, that the chest may be immovable. Swimming and leaping are shown by M. Bourdon to be impossible unless it is closed; for he prevented them by inserting a tube into a wound made by him in the trachea of poor brutes.

Although, with the exception of mocking birds, brutes make no articulate sounds, they have a language perfectly intelligible to one another. They make one noise to express joy, another terror, another to summon their young, &c., and comprehend the meaning of sounds made by us, not only of an inarticulate kind, but also articulated. The sagacity of some dogs in this respect is astonishing. "They learn to understand not merely separate words or articulate sounds, but whole sentences expressing many ideas. I have often spoken," continues Gall, "intentionally of objects which might interest my dog, taking care not to mention his name, or make any intonation or gesture which might awaken his attention. He, however, showed no less pleasure or sorrow, as it might be; and, indeed, manifested by his behaviour that he had perfectly understood the conversation which concerned him. I had taken a bitch from Vienna to Paris; in a very short time she comprehended French as well as German, of which I satisfied myself by repeating before her whole sentences in both languages."[a] An accurate observer of nature, and one familiar with brutes, Hogg, the late Ettrick shepherd poet, to substantiate the same opinion, relates the following anecdote. He was going to visit

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[x] l. c. p. 298. sq.

[y] *El. Physiol.* lib. viii. sect. iv. p. xxx—xl.

[z] *London Medical Gazette,* June 27, 1834.

[a] *Sur les Fonctions du Cerveau,* t. v. p. 49. sq.

a friend for a fortnight, but was desirous that a particular dog should not accompany him, as it was always " breeding some uproar." While the animal was near him he mentioned his intention to his mother in the evening. The dog was to be locked up till some time after he had started. But in the morning, when the time came, it was not to be found. " The d—'s in that beast," said he, " I will wager that he heard what we were saying yesternight, and has gone off for Bowerhope as soon as the door was opened this morning." A great flood had taken place in the night, so that the Yarrow was impassable, and Hogg had to go by St Mary's Loch, and cross in a boat. But though it appeared impassable by any living creature, the dog had swam it early in the morning, and was found by Hogg, "sitting, 'like a drookit hen,' on a knowl at the east end of his friend's house, awaiting his arrival with great impatience." [b]

As the exertion of every power is a gratification, brutes take an intense pleasure in making the noises of which they are capable. The singing of some birds, and the chattering and squalling of others, are examples of this.

The voice of some small brutes is, like the muscular powers of others, far greater than in large animals proportionally, and of some even absolutely. A grasshopper, weighing an eighth of an ounce, may be heard at the distance of the sixteenth of a mile; and Americans have calculated that a man, weighing as much as 1600 grasshoppers, were his voice in proportion, would be audible at the distance of 1000 miles, and when he sneezed would cause the house to be in danger of falling, as the walls of Jericho tumbled at the sound of the trumpet.

[b] Blackwood's *Edinburgh Magazine*. Feb. 1824.

CHAP. XXII.

THE EXTERNAL SENSES IN GENERAL, AND TOUCH IN PARTICULAR.

"The other office of the nerves we found to consist in communicating to the sensorium" (or organ of the mind) "the impressions made by external objects. This is accomplished by the external senses, which are, as it were, the watchmen of the body and informers of the mind."

The external senses are usually considered to be five:—Touch, taste, smell, sight, and hearing. But our feelings referrible to sensation or consciousness are very numerous. Besides our strictly mental feelings, we have a great variety of feelings in the body at large. To say nothing of hunger and thirst, we may feel weak or strong. The sensation of weakness is very distressing, and often complained of in the epigastric region. The removal of this makes us cognisant of a feeling of which otherwise we think but little,—a feeling of general support and mutual elastic resistance, as it were, between all the particles of the frame: and exhaustion makes us conscious of what was the comfort of this feeling. We feel the state of our muscles, whether they are relaxed or contracted, or at least the position of the parts which they move. We feel the state of tone or exhaustion of muscles. We feel heat and cold in their various degrees, pains, and endless uneasy sensations of distension, weight, pricking, smarting, &c. &c., a large number of which are usually referred to the sense of touch. But the sensation induced mechanically by the contact of something with us is properly called touch. Forms of sensation may be peculiar to certain parts.

"The five external senses alone belong to our present subject. For to regard, with Gorter, the stimulus which inclines us to relieve the intestines," &c., as so many distinct senses, is unnecessary minuteness, as Haller long since observed.[a]

[a] "J. De Gorter, *Exercitationes Medicæ*, iv. Amst. 1737. 4to."

By means of the external senses only do we learn the existence of the world around us. "With every sense an animal discovers a new world; thus creation is to it increased or diminished accordingly as its senses are more or less numerous." "Provided with senses, it enters into communication with the university of nature, and associates with surrounding beings; a continual action and reaction are established between animate and inanimate nature."[b] They are the seat of almost constant gratification. Without them, indeed, we should not only be ignorant of the surrounding world, but our mental faculties would never come into operation. We could not judge of objects of sight, hearing, or touch, by our lower intellectual faculties; nor would our higher intellectual faculties come into play, nor our various inclinations be called forth. Some writers, hardly deserving the name of philosophers, have been misled by these truths, and declared that the external senses give rise to our intellectual and moral powers. Were this the case, persons of acute external sense, and those numerous savages and brutes which surpass us in one external sense or other, would be the most eminent in intellect. Gall found it necessary to refute these errors at length.[c] Not even can an organ of external sense give rise to a sensation, except in the brain, or what is tantamount to brain in every brute.

Gall observes that,

"1. Every nerve of sense has its particular origin: no one arises from the brain, or from another nerve; but the filaments of each proceed from particular masses of pulpy substance.

"2. Each nerve of sense differs from the others in size, structure, colour, and consistence.

"3. The apparatus of some nerves are more or less complicated, more or less numerous in the different kinds of animals.

"4. There is no proportion, either direct or constantly uniform, between the size of the brain and of the nerves.

"5. There is no fixed proportion between the nerves of sense in the different kinds of animals, nor in individuals of the same species.

"6. The female has not nerves of sense larger or smaller than the male.

[b] Gall, l. c. 4to. vol. i. p. 149.

[c] Ibid. ll. cc. 4to. vol. i. p. 223. sqq.; also p. 149. sqq. 8vo. t. i. p.114. sqq.

"7. In different species of animals, and in individuals of the same species, the nerves of sense are developed and decline at very different periods.

"8. No decussation of any other nerve than the optic is at present known, and its decussation is not found in all species of animals.

"9. The corresponding nerves of each side communicate together by commissures, and in other parts of the brain by branches."

Again, that,

"1. To the functions of the senses, material instruments are indispensable.

"2. That the nerves merely communicate the impression of the external world to the brain that it may be modified by this.

"3. Every nerve of sense can receive but certain impressions, and the functions of one sense cannot be performed by another.

"4. The delicacy of every sense is ordinarily proportionate to the perfection and development of the apparatus, and probably also to the number of apparatus.

"5. The particular functions of the senses have not the same force in different species of animals, nor in different animals of the same species: the animal which has acute sight may have dull hearing.

"6. The nervous system of the senses may, like other systems, acquire a higher activity by unusual irritants, from inflammation, &c.

"7. The derangement of the functions of the senses that follow lesion of the brain do not affect the opposite side any more than those of the spinal chord, at least according to my present experience.

"8. The functions of the different senses manifest themselves at different periods, according to the development of these organs. It is asked how, and for what purpose, some animals are born with senses perfectly developed, at least with the eyes and ears open, and others with them closed. This peculiarity is not always in relation to the power of using the extremities more or less promptly; for the new-born child is as incapable of locomotion as the new-born puppy.

"9. All the functions of the senses gradually decline in old age." According to some physiologists this is the result only of the

organs of the senses becoming habituated to external impressions, so that these are continually less and less strong. But in old age the functions of the senses grow weak, because the organs of the senses diminish. The nervous filaments, and their nutrient substance, waste, as well as the pulpy substance in general, and all the nerves begin to atrophy. Hence Pinel did not find, in the labyrinth of deaf old men, the soft substance which exists in men who hear. Hence the nerves of old persons are much smaller than of those in the vigour of life. As this diminution does not occur at the same time in all the nervous system, it follows that all the functions do not decline equally at the same time, as would be the case if they declined more and more only by habituation to impressions. Some even explain by habit the fact of our having in health no sensation of what is passing within us in our organic or automatic life. I should ascribe this rather to an original design of nature, which probably accomplishes it by the tenuity of the filaments that communicate between the nervous system of the chest and abdomen and the nervous system of the vertebral column, the senses, and the brain.

" 10. The doubleness of any sense does not prevent our sensation of objects from being simple: in the same manner our consciousness is single, notwithstanding the five different functions of the senses."

A sensation lasts a certain time after the exciting cause has ceased. Thus, if a piece of wood, with one end ignited, is whirled round, we see a luminous ring; the sensation produced by the wood in each point of the circle continuing till the wood arrives at that point again: a rocket forms a train. A sensation is sometimes renewed, as when, after having looked at the sun, we close our eyes and its figure returns. According to the law of all vital excitement, sensations are more acute the less they have been excited, and *vice versa*. Thus, after having been in a strong light, we at first see nothing on entering a darkened apartment, but gradually distinguish objects in it, and, on returning into the light, find the glare very disagreeable: the same tepid water feels warm to one hand previously immersed in cold water, and cold to the other previously placed in warm water.

" *Touch* merits our first attention, because it is the first to manifest itself after birth, its organ is most extensively spread

over the whole surface, and it is affected by many properties of external objects."

"It is less fallacious than the rest of the senses, and by culture capable of such perfection as in some measure to supply the deficiency of others, particularly of vision.[d]

The direct pleasure of the sense of touch is far more exquisite than of any other sense, and is therefore employed by nature for the raptures of sexual intercourse.

"The skin, whose structure we formerly examined, is the general organ of touch.[e] The immediate seat of the sense is the papillæ of the corium, of various forms in different parts, commonly resembling warts[f], in some places fungous[g], in others filamentous.[h] The extremities of all the cutaneous nerves terminate in these under the form of pulpy penicilli."

The nerves of general sensibility, and as far as we know of touch in particular, are the ganglionic portion of the trigeminum and the ganglionic or posterior spinal nerves and all their ramifications.

"The *hands* are the principal organs of touch, properly so called, and regarded as the sense which examines solidity; and their skin has many peculiarities. In the palms and on each side of the joints of the fingers, it is furrowed and free from hairs, to facilitate the closing of the hand: and the extremities

[d] "Consult Rol. Martin, *Schwed. Abhandl.* vol. xxxix. 1777.
G. Bew, *Memoirs of the Society of Manchester*, vol. i. p. 159.
Ch. Hutton, *Mathematical Dictionary*, vol. i. p. 214."

"Lecat speaks of a sculptor, Ganibasius de Volterre, who, being blind, felt faces, and then modelled them in clay. The man of Puiseaux, born blind, estimated the distance of the fire by the degree of heat, and of bodies by the action of air upon his face. Saunderson, by exploring a series of medals with his hands, distinguished the genuine from the spurious, although the latter were so well counterfeited as to deceive a connoisseur with good eyes; and he judged of the accuracy of mathematical instruments by passing the ends of his fingers upon their divisions. Like the blind man of Puiseaux, he was affected by the least vicissitude of the atmosphere, and could perceive, especially in calm weather, the presence of objects not more than some paces distant." Gall. l. 4to. vol. i. p. 222.

[e] "F. De Riet, *De Organo Tactus.* L.B. 1743. 4to. reprinted in Haller's Anatomical Collection, t. iv."

[f] "Dav. Corn. de Courcelles, *Icones Musculor. Capitis.* Tab. i. fig. 2, 3."

[g] "B. S. Albinus, *Annotat. Academ.* l. iii. tab. iv. fig. 1, 2."

[h] "Ruysch, *Thesaur. Anat.* iii. tab. iv. fig. 1. *Thes.* vii. tab. ii. fig. 5. B. S. Albinus, l. c. L. vi. tab. ii. fig. 3, 4."

of both fingers and toes are ridged internally by very beautiful lines more or less spiral [i]; and are shielded externally by nails.

"These scutiform *nails* [k] are bestowed upon man and a few other genera of mammalia only (we allude to the quadrumana which excel in the sense of touch) [l], for the purpose of resisting pressure, and thus assisting the action of the fingers, while examining objects.

"They are of a horny nature, but on the whole very similar to the epidermis. For under them lies the reticulum, which in negroes is black [m]; and under this again is found the corium, adhering firmly to the periosteum of the last phalanx. These constituent parts of the nails are striated lengthwise. The posterior edge, which, in the hands, is remarkable for a little lunated appearance, is fixed in a furrow of the skin; and the nails, growing constantly from this, are protruded forwards, so as to be perfectly renewed about every six months."

Dr. Breschet considers that the organ of touch is not a mere nerve, but that an apparatus exists as in the eye and ear: — that, like the optic nerve entering the sclerotic, the nerves of touch lose their neurilema on entering the cutis and derive a new covering from its outer part, and then, terminating in a round extremity or projecting papilla, are covered by a thin layer of epidermis indispensable to the sense of touch.[n]

Weber has shown that the tactile power of the skin is not proportionate to its sensibility. Thus the mammæ are easily tickled,

[i] "Grew, *Phil. Trans.* No. 159."

[k] "B. S. Albinus, *Annotat. Academ.* l. ii. tab. vii. fig. 4, 5, 6."

[l] "Namely, simiæ, papiones, cercopitheci, and lemures, the apices of whose fingers in their four hands are very soft, and marked, as in the human subject, with spiral lines.

"Physiologists have disputed whether the sense of touch is bestowed on any besides man and the *quadrumana*." "On one side, I would grant to both parties that the snowy hands of a delicate girl must enjoy a much more exquisite sense of touch than what I call the fingers of brutes. But, on the other, I have frequently seen simiæ and papiones possessing much softer fingers, and using these fingers to explore surfaces much more dexterously, than many barbarous nations and innumerable persons among the lower orders of Europeans whose hands have been hardened by labour."

[m] "B. S. Albinus, *De Habitu et Colore Æthiopum*, fig. 3."

[n] *Nouvelles Recherches sur la Structure de la Peau*, par M. G. Breschet. Paris, 1835.

and susceptible of great pain when irritated, and yet are very moderately endowed with the sense of touch. The armpits, flanks, soles, and other ticklish parts have a comparatively slight power of distinguishing objects by touch. "Who was ever made to laugh by tickling the ends of his fingers? and yet they are possessed of a tactile accuracy far exceeding that of any other portion of the skin." Mere sensibility exists in all the surfaces and solids, and under disease may give sensations; and in some internal parts, as the upper and lower part of the alimentary canal, we continually have sensation: but, whatever be the irritation of the stomach or bowels or larynx, substances within them are felt very indistinctly.

The different parts of the skin vary exceedingly in their tactile power. Weber remarks that, if the skin of a person whose eyes are shut is touched with the two points of a compass an inch asunder, he at once perceives that he is touched in two places. But, by moving the points nearer and nearer to each other, the skin feels at length as if touched by simply one body, and this body feels as if rather longer in the line of junction of the points of the compass. There is, however, the greatest difference in different parts as to their power of still feeling that there are two bodies when these are approximated. The tips of the fingers and of the tongue distinguish the bodies at the smallest distance; while the middle of the arm and thigh, the centre of the cervical and dorsal spine, cease the soonest to distinguish at large distances. In himself Weber found the tip of the tongue distinguish two bodies, as well in their horizontal as perpendicular direction, till their distance from each other was within half a French line; the inner surface of the tips of the fingers within one, &c.

He lays it down as a law, that, the more gifted with touch are any portions of the skin, the greater will the distance appear of any two bodies from each other though placed at the very same distance. Thus, "if the points of a compass, distant from each other one or two lines, applied to the cheek, just before the ear, be then moved successively to several parts of the cheek, we shall find, on approaching the angle of the mouth, that the points will appear to recede from each other;" or, if the ends of the forefinger and thumb are held together, and their tips passed in a

line from the ear to the upper or under lip, they will feel more and more distant from each other as they approach these.

If the points of the compass, kept at the same distance from each other, are applied to two contiguous surfaces, enjoying voluntary motion, as to the two lips, they will appear more distant than when applied to one surface: in fact in the case of the lips, though, when distant from each other half a line, they appear as two, yet, if applied to one lip only, they appear as one. Nay the points, though at the same distance from each other, will seem more distant when applied to two portions of the skin differing in structure and function, than when applied to portions resembling each other, even though more sensible. Thus, if the points are placed one upon the inner surface, and one upon the red outer part of the lips, they appear more distant from each other than when both are applied, though at the same distance, on the outer red surface which is so much more sensible.

When the points of the compass are placed horizontally on the axis of a limb, they are distinguished as two more clearly than when placed vertically. But the reverse occurs, if they are placed on the trunk.[o]

He finds the left hand more sensible of temperature than the right in most persons, probably from its epidermis being thinner through less use. When the hands, being of the same temperature, were plunged into separate vessels of hot water, as the person lay in bed, the left hand was believed to be in hotter water, though the temperature was two degrees lower than that of the water in the other vessel. A difference of one third of a degree is readily detected by the hand if placed successively in two vessels of water. The judgment is more accurate when the temperature is not much above or below the usual temperature of the body; water at 98° being more readily distinguished from water at 100°, than water at 120° from water at 118°; just as sounds are best discriminated when neither very acute nor base nor loud. A large surface receives stronger impressions than a smaller. If the forefinger of one hand is immersed

[o] I have always been struck with the erroneous judgment I form of the spot of the trunk, or arms, or legs, in which an itching or tingling is felt. So satisfied in general am I that I cannot put my finger on the spot where I feel the tingling, unless I use my eyes, that I have frequently amused myself with observing what a blunder I was sure to make.

in water at 104°, and the whole of the other hand in water at 102°, the cooler water will be thought the warmer: and water, borne by a forefinger, will seem to scald the whole hand. Minute differences are appreciated by plunging the whole hand successively into two vessels of hot water, which are imperceptible to a single finger.

Differences of temperature and weight are best ascertained when the perceptions are not simultaneous, but successive: just as is the case with differences in objects of taste, smell, and hearing. If an acid and a sweet substance are applied to the tongue with pencils in rapid succession, they are nicely distinguished: but not if applied together. It is the same if two vials of odorous fluids are applied to the nostrils; and two notes are always better distinguished if struck in succession than together. Vision is no exception, because, although we compare two lines best when placed side by side, we in fact do not view them simultaneously, but in rapid succession; since nothing is seen accurately unless its image falls on the retina at the extremity of the optic axis.

Persons differ greatly in their power of estimating weight, and practice increases it considerably. Men accustomed to estimate weights by poising them will distinguish a difference of a thirtieth part in two bodies. They use the same hand for each weight in instant succession. The intervention of a few seconds does not prevent accuracy. A true estimate may be made although the second weight is poised twenty seconds after the first; but an interval of forty seconds prevents accuracy. The sense of sight is more accurate, for a well-practised eye will distinguish a difference of a hundredth part in the length of two lines: and the ear surpasses the eye, for a well-practised musical ear will distinguish between two sounds differing only $\frac{1}{320}$,— the number of vibrations being calculated that are made by the sounding bodies in a given time. If two lines differ only $\frac{1}{11}$ in length, the difference may be perceived although the one is looked at fifty or sixty seconds after the other. If they differ $\frac{1}{21}$, an interval of thirty-five seconds may elapse. If they differ $\frac{1}{50}$, an interval of three seconds is the longest compatible with accurate judgment.[p]

Not only does touch appear too general an expression for the

[p] *De Pulsu, Resorptione, Auditu et Tactu. Annotationes Anatomicæ et Physiologicæ*, auctore Henrico Ernesto Weber. Lipsiæ, 1834.; and Dr. Graves's Analysis of it, in the *Dublin Journal of Medical Science*, March 1836.

endless feelings of which we are susceptible, but some feelings, apparently referred with justice to this sense, are considered by many writers as referrible to other modes of sensation. Dr. Spurzheim[q] says, "It may still be asked whether feeling produces ideas of consistency, of hardness, of softness, of solidity and fluidity, of weight and resistance? I think it does not. For the mind to examine these qualities employs the muscular system rather than the sense of feeling properly so called." This opi, nion accords with that of Dr. Brown[r], who states, "The feeling of resistance" (of which he considers the qualities enumerated above as modifications) "is, I conceive, to be ascribed, not to our organ of touch, but to our muscular frame, to which I have already directed your attention, as forming a distinct organ of sense; the affections of which, particularly as existing in combination with other feelings, and modifying our judgments concerning these (as in the case of distant vision, for example), are not less important than those of our other sensitive organs. The sensations of this class are, indeed, in common circumstances, so obscure as to be scarcely heeded or remembered by us; but there is probably no contraction, even of a single muscle, which is not attended with some faint degree of sensation that distinguishes it from the contractions of other muscles, or from other degrees of contraction of the same muscle."

This opinion was originally advanced by the profoundest physician among my predecessors at St. Thomas's Hospital,—Dr. Wells[s], in the following words:—"What is there within us to indicate these positions of the body? To me it appears evident, that, since they are occasioned and preserved by combinations of the actions of various voluntary muscles, some feeling must attend every such combination, which suggests, from experience, perhaps, the particular position produced by it. But in almost all the positions of the body, the chief part of our muscular efforts is directed toward sustaining it against the influence of its own gravity. Each position, therefore, in which this takes place, must be attended with a feeling which serves to indicate its relation to the horizontal plane of the earth."

Sir C. Bell has repeated these opinions, but without any refer-

[q] *Phrenology.*
[r] *Lectures on the Philosophy of the Human Mind.* 2d edit. 1824. p. 480.
[s] *Essays,* 1818. p. 70.

ence to Dr. Wells or the other two physicians, although he shows himself acquainted with Dr. Wells's writings.[t]

"Why are nerves, whose office is to convey sensation, profusely given to muscles, in addition to those motor nerves which are given to excite their motions? To solve this question, we must determine whether muscles have any other purpose to serve than merely to contract under the influence of motor nerves. For if they have reflective influence, and if their condition is to be felt or conceived, it will presently appear that the motor nerves are not suitable internuncii betwixt them and the sensorium. I shall first inquire if it be necessary to the governance of the muscular frame, that there be a consciousness of the state or degree of action of the muscles? That we have a sense of the condition of the muscles appears from this: that we feel the effects of over-exertion or weariness, and are excruciated by spasms, and feel the irksomeness of continued position. We possess a power of weighing in the hand; what is this but estimating the muscular force? We are sensible of the most minute changes of muscular exertion, by which we know the position of the body and limbs, when there is no other means of knowledge open to us. If a rope-dancer measures his steps by the eye, yet, on the other hand, a blind man can balance his body. In standing, walking, and running, every effort of voluntary power which gives motion to the body is directed by a sense of the condition of the muscles, and without this sense we could not regulate their actions, and a very principal inlet to knowledge would be cut off."[u]

Weber illustrates this opinion of Dr. Wells, by supporting the hands of a blindfolded person on cushions, and placing unequal weights upon them. If the difference is great, it will be felt. But, if it is small, it will not be noticed till the hands are raised, — till the muscles feel what resistance they have to act against. Weber found in most men a more accurate sense of the amount of pressure on the left side than on the right. A minute substance in contact with the skin is always judged to be perpendicularly situated in regard to it, as rays of light are always seen in a

[t] The British Association has allowed the compiler of the report on the Physiology of the Nervous System, to refer to Sir C. Bell alone on this point, without any allusion to the previous writings of Dr. Wells, Dr. Brown, or Dr. Spurzheim.

[u] *Phil. Trans.* 1826.

direction perpendicular to the point at which they impinge on the retina. It may be said, that, if a hair is pulled, we do not conceive it to be pulled perpendicularly whatever be the direction. But Weber replies that we judge here of the direction by the direction of the muscular effort necessary to keep the head steady at the time. If muscles are not called into play, but the head is held steady by one person while another presses firmly around the hair, the direction, whatever it be, in which the hair is pulled, cannot be judged of.

We have seen that Dr. Spurzheim thought he had established a cerebral organ for judging of these sensations of weight or resistance.[x]

The varieties of the feelings both of consciousness and sensation in the animal kingdom must be infinite. Brutes probably have sensations from the external world of which we are insusceptible, and those especially which are minute are no doubt sensible to external circumstances, which are far too delicate to produce an impression upon us. Every animal is destined for a certain peculiarity and amount of sensation from certain substances and circumstances, in accordance with the destination of its mode of existence. Brutes will feel the approach of changes in the weather long before we are aware of what is coming; and know even the direction of a coming storm.

All brutes most probably have the sense of touch: and the more delicate and soft the external parts which come in contact with surrounding substances,

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[x] Gall is very philosophical and eloquent in overthrowing the doctrine of excellence of touch being the source of superiority of intellect, and of this sense especially rectifying others and giving us a better knowledge of the external world, ll. cc. 4to. p. 208. sqq. 8vo. t. i. p. 85. sqq. Those who have not read both his large and octavo work may not be aware for what absurdities he had to oppose Buffon, Condillac, Cuvier, Herder, Richerand, Vicq d'Azyr, blind followers of Anaxagoras and Galen.

As *philosophers* have ascribed the superiority of man's intellect to his hand, and of the elephant's to its trunk, the constructiveness of the beaver to its tail, and the ferocity of the tiger to its teeth and claws, the poor man may be excused who was lately executed at Chelmsford, and left the following directions: — "I, Edward Clarke, now in a few hours expecting to die, do sincerely wish, as my last request, that three of my fingers be given to my three children, as a warning to them, as my *fingers* were the cause of bringing myself to the gallows and my children to poverty." The request was complied with by the surgeon. *Examiner.* April 23. 1837.

the more delicate and acute, with an equal supply of nerves, will be the sense. Many without hands, as organs of touch, have other organs to compensate for their absence. "We observe, even from the polygastric animalcules, that organs are developed at the anterior part of the body, which appear to be adapted to communicate sensations corresponding with those of touch in the higher animals. They have long cilia, almost already developed into tentacula; and those tentacula, so common in the class of zoophytes, appear to be endowed with great delicacy of feeling. Those fleshy and sensitive tentacula and tubular feet of the radiated animals continue up through many of the succeeding classes of animals, becoming jointed in the articulated classes, where they form palpi and antennæ; and in the soft molluscous classes they again assume the form and name of tentacula,—soft, sensitive, and fleshy, without any jointed appearance. We observe remnants of those sensitive organs even in the class of fishes in the form of processes or filaments still disposed as organs of touch around the mouth." "Many fishes and higher animals are covered with dense scales which must deaden the general sense of touch over the surface of their bodies: other fishes have the lower part of the head, the lower part of the abdomen, the circumference of the mouth, and other exposed parts, covered with a naked, delicate, and soft integument, which will compensate for the want of development of the arms and hands as organs of touch. But in the land amphibious animals, and in all the higher vertebrata, we observe the anterior extremities to become more delicately organised, and fit for communicating delicate impressions of the forms, densities, and other physical qualities of external bodies; and in proportion to the high nervous sensibility, the vascularity, the flexibility, and the softness of the hands and other external cutaneous parts, will that common sense of touch become increased as we pass up through the vertebrated classes to man, who surpasses all inferior animals in the exquisite and equal development of all his organs of sense, and in the perfection of all those higher organs of relation by which animals are more immediately connected with outward nature." (Dr. Grant's *Lectures. Lancet,* No. 569.)

I presume that the tongue must be considered as an organ of touch as well as of taste; and the snout in the mole and pig; the moist upper lip in the rhinoceros; the proboscis of the elephant; and the lower end of the tails of apes called sapajous. The whiskers of the "feline and other mammalia probably serve to make the proximity of bodies known to the animal. The seal has a very long infra-orbital branch of the fifth pair, with about forty branches, which are distributed to the upper lip, and many of which have been traced by Blumenbach to the roots of the strong whiskers." (*Manual of Comparative Anatomy*, translated by Messrs. Laurence and Coulson, p. 259. sq.)

CHAP. XXIII.

TASTE.

"We perceive tastes by the tongue, and in some degree," says Blumenbach, in conformity with the common opinion, "by the other neighbouring internal cutaneous parts of the mouth, especially by the soft palate, the fauces, the interior of the cheeks, and lips; by them, however, we taste only what is acrid and very bitter[a]:" and Dr. Vimont says that, on touching the lips, inside of the cheeks, and the palate, with a very concentrated solution of common salt, with strong vinegar, and pure alcohol, their respective tastes were not experienced, while he instantly had the taste of each when brought in contact with the upper surface of the tongue.[b]

The most careful and extensive experiments have been made by M. M. Guyot and Admyrauld[c], and they declare the lips, the internal surface of the cheeks, the hard palate, and the pharynx, to be utterly destitute of taste; the soft palate to be also destitute, *except at one spot*, commencing about a line below its union with the hard palate, descending to within three or four lines of the base of the uvula, and extending indefinitely on each side till lost insensibly; and the tongue to be destitute at its lower part and all its dorsal surface. So that the only seats of taste are the small space in the soft palate, that portion of the base of the tongue behind a curved line drawn with its concavity forwards and passing through the blind foramen, and the whole of the circumference of the organ, on the upper part of which the sense extends a little farther towards the middle of the organ, especially near the apex, than on the lower; and the portion at the

[a] "Grew, *Anatomy of Plants*, p. 284. sq.
Petr. Luchtmans, *De Saporibus et Gustu.* L.B. 1758. 4to. p. 58. sqq.
J. Gottl. Leidenfrost, *De sensu qui in faucibus est, ab eo qui in lingua exercetur, diverso* Duisb. 1771. 4to."

[b] *Traité de Phrén.* vol. ii. p. 138. sq.

[c] *Mémoire sur le Siége du Gout, chez l'Homme,* Paris, 1830.

apex has a more acute taste than the rest of the circumference. These gentlemen remark that the seats of taste, as ascertained by them, are the most favourably placed for the exercise of the sense. Substances have the apex of the tongue applied to them as soon as they are moistened by the lips; the softer portions fall during mastication, some within the alveolar arch in contact with the circumference of the tongue, and others without it, but these are immediately pressed over to the circumference of the tongue by the cheeks; while the food is compressed between the dorsum of the tongue and hard palate, going through a kind of mastication for which the firmness and moderate sensibility of the dorsum render it peculiarly fit, the fluid portions are expressed and run over to the circumference; and, finally, the bolus, when properly moistened and fit for deglutition, is pressed between the base of the tongue and the central gustatory space in the soft palate.

"The chief organ of taste is the *tongue*[d], agile, extremely ready, changeable in form; in its remarkably fleshy nature, not unlike the heart; and endowed with far more excitability than any other voluntary muscle.[e]

"Its integuments resemble the skin. They are, an epithelium, performing the office of cuticle; the reticulum Malpighianum[f]; and a papillary membrane, but little different from the corium.

"The integuments of the tongue differ from the skin chiefly in these respects — in the epithelium being moistened, not by the oily fluid of the skin, but by a mucus which proceeds from the foramen cæcum of Meibomius[g] and the rest of the glandular expansion of Morgagni[h], and, secondly, in the conformation of the papillæ, which are commonly divided into petiolated, obtuse, and conical.[i] The first are in very small number and situated in

[d] "Sömmerring, *Icones Organorum Humanorum Gustus.* Francof. 1808. ol."

[e] "This fact, contrary to the opinion of others, I have proved by dissection of living animals, and by pathological observation. *Specimen Historiæ Naturalis ex auctoribus classicis illustratæ.* Gotting. 1816. 4to. p. 4. sqq."

[f] "In dogs and sheep with variegated skin, I have commonly found the reticulum of the tongue and fauces also variegated."

[g] "Consult Just. Schrader, *Observat. et Histor.* from Harvey's book *De Generatione Animalium.* p. 186."

[h] "Morgagni, *Adversar. Anat. Prima.* Tab. 1."

[i] "Ruysch, *Thesaur. Anat.* 1. tab. iv. fig. 6.
B. S. Albinus, *Annotat. Acad.* l. i. tab. 1. fig. 6—11."

a lunated series at the root of the tongue; the others, of various magnitudes, lie promiscuously upon the back of the tongue, and chiefly upon its edges and apex.[k] The tongue is furnished with nerves by the lingual branch of the fifth pair[l]," by the hypoglossal, and the glosso-pharyngeal. The first gives common sensibility; the second, motion; the latter, the sense of taste: as is shown by Dr. Panizza.[m]

The glosso-pharyngeal or gustatory nerve commences by two, three, or more filaments, from the chorda oblongata, at a part of Sir C. Bell's respiratory tract, unluckily, and emerges between the corpora olivaria and restiformia.[n] It has no communication with the other nerves of the tongue: and gives off no muscular filaments. It is distributed to the mucous membrane of the tongue, epiglottis, tonsils, and upper part of the pharynx. It communicates both with the vidian or recurrent pterygoid nerve of the spheno-palatine ganglion, or at least a branch of it runs some way with a branch of this, and with a branch of the facial, or at least runs also with this; for I cannot conceive nerves of sensation and motion really to mingle in their course and form a third nerve, however they may mingle in ganglia or the encephalo-spinal mass or in plexuses, in order that the nerve of sensation may influence the nerve of motion, which must still run on, I imagine, afterwards distinct, as before: it communicates with the pneumono-gastric, superior cervical ganglion, and with the pharyngeal plexus, in all probability for influencing these parts: and we know how great is the sympathy of the organs of taste with the pharynx and stomach, &c.

Blumenbach correctly states that "the ninth pair[o]," "which also supplies the tongue[p], appears intended rather for the various move-

[k] "Consult Haller's excellent description of the tongue of a *living man*, in the *Dictionn. Encyclopédique*. Yverdon, vol. xxii. p. 28."

[l] "J. Fr. Meckel, *De Quinto Pare Nervorum Cerebri*. Gotting. 1748. 4to. p. 97. fig. 8. n. 80."

[m] *Ricerche sperimentali sopra i nervi. Lettera del Professore Bartolomeo Panizza al Professore Maurizio Bufalini*. Pavia, 1834.

[n] Gall, l. c. 4to. vol. i. p. 102.

[o] "J. F. W. Böhmer, *De Nono Pare Nervorum Cerebri*. Gotting. 1777. 4to."

[p] "See Haller, *Icon. Anatom.* fasc. ii. tab. 1. letter g.
Monro, *On the Nervous System*. Tab. xxvi."

ments of the organ, in manducation, deglutition, speaking, &c.[q] But, like most others, he believes that the lingual branch of the fifth pair is for taste; and the glosso-pharyngeal, as well as hypoglossal, for motion.

Professor Panizza has lately demonstrated that the lingual is for common sensibility, and the glosso-pharyngeal for taste. When the hypoglossal was divided by him in a dog or sheep, the tongue instantly lost all motion. If milk was offered, the animal hastily advanced and made the movements of lapping with the head and lower jaw, but the tongue lay motionless in the mouth, and the animal at last gave up all attempts to lap. If soaked bread was offered, he took it into his mouth, and attempted to masticate, but suddenly laid it down, scarcely divided into two pieces, one of which he took up again, subdivided, and treated in the same way, till the fragments were on the ground and abandoned by him. If his tongue rolled out of his mouth, it so remained, and was bitten till he howled again. The tongue no more assisted in the process of deglutition than of mastication. If solid food was placed on the tongue, and did not fall off into the pharynx, between the tongue and the teeth, or out of the mouth, by the motion of the head and lower jaw, it was found there after many hours. If by these motions it tumbled into the pharynx and was swallowed, deglutition was still imperfect, because

[q] Besides the well-known ganglion petrosum of the glosso-pharyngeal nerve, Dr. Müller of Berlin has discovered another ganglion on this nerve in the human subject. He describes it as situated within the cavity of the cranium near the jugular foramen, as being very inconsiderable in size (not more than a millimetre, $\frac{1}{30}$ inch, in length), and as belonging, not to the whole root of the nerve, but only to one of its fasciculi, which fasciculus, he adds, arises from the same region of the chorda oblongata as the rest of the nerves.

Dr. Mayer of Bonn has observed two small ganglia on the root of the glosso-pharyngeal nerve of the ox. Each is placed on a separate fasciculus of the nerve near to but within the place where it pierces the dura mater.

Dr. Mayer has also discovered that the hypoglossal in the ox, dog, and pig has a posterior as well as an anterior root. The posterior root, which is very delicate, arises from the posterior surface of the chorda oblongata, passes over the accessory nerve (without, however, being connected with it) forms a small ganglion, from which it emerges augmented in size, and joins the anterior root. Dr. Mayer has once, but only once, observed this posterior root and its ganglion in the human subject. Dr. Müller could never discover it in man, but has seen it distinctly in the ox. See Müller's *Handbuch der Physiologie*, p.589., and Dr. Mayer in the *Acta Acad. Cæs. Leop. Nat. Cur.* vol. xvi. p. ii.

the mass, when squeezed by the superior pharyngeal muscle, partly returned into the mouth from the tongue being unable to close the isthmus of the fauces and thus compel it to take altogether a downward course. There was the same difficulty if fluid was poured into the fauces. If the sheep took vegetable substances between its teeth or lips, he could not draw them into his mouth, and his bleat became hoarse and feeble. That the sensibility of the tongue was unimpaired, was shown, if it was pricked near the tip, or base, or at the centre, by the animal howling if he bit it, by the efforts, already mentioned, to dislodge a morsel placed upon it, by his shaking his head with his mouth open to reinstate it if in making the experiments it had been folded back, and by his efforts to vomit, as well as by his expressions of pain, whenever the tongue was pricked at the base. That taste continued, was shown by the disgust expressed whenever a solution of colocynth, which is neither acrid nor odorous, was placed upon the tongue.

When the two lingual branches of the fifth pair had been divided, the animal licked, lapped, ate, and drank as before; and colocynth placed upon its tongue carefully, so as to touch no other part, instantly excited disgust; so that motion and taste were unimpaired, but the tongue might be burnt and wounded in all ways without the animal expressing pain.

If both the hypoglossal and lingual branches were divided, motion and sensibility were lost, but taste still remained perfect.

If the glosso-pharyngeal pair was divided, motion and sensibility were unimpaired, but colocynth and any other nauseous substance that had no smell produced no disgust, and was swallowed with the same avidity as the most agreeable, and the vessel which contained it was licked out clean. A dog, in which the lingual nerves only had been divided, and which was swallowing some meat, swallowed hastily also a piece made bitter, but was seized with vomiting and compelled to disgorge it as soon as it reached the gullet: but the dog in which the glosso-pharyngeal had been divided, ate up the very piece instantly, and gave no sign of finding it disagreeable. Yet this same dog expressed great suffering if his tongue was pricked with a needle.

If the hypoglossal was pinched immediately after death, the tongue moved: but no such effect resulted from pinching the lingual or glosso-pharyngeal nerve. The glosso-pharyngeal, Professor Panizza observes, both in man and brutes, gives no

filaments to the muscles among which it passes, but is wholly distributed to the nervous membrane of the tongue and other parts which are likewise the seat of taste; and its filaments are the most abundant at the base of the tongue, where taste is the most acute.

We are thus gratified at witnessing an uniformity with the other organs of sense. They have one set of nerves for their muscles; another for their common sensibility or touch, and this is the same as that possessed by the tongue, or the trigeminus; and a distinct nerve for their specific sense. Sir C. Bell, having found the glosso-pharyngeal arise in his respiratory tract, called it a respiratory nerve, and made it preside over deglutition; while he considered the lingual to be the nerve of the specific sense, though it does not arise distinctly like the olfactory, optic, and acoustic, but is a mere branch of a nerve of touch — of the trigeminus, which he very properly classes with the double spinal nerves. "The extraordinary part of this speculation is," Dr. Panizza remarks, "that, among the arguments by which the various opinions were supported, the anatomical distribution of each nerve was uniformly adduced; so true it is that prejudice obscures the observation as well as warps the judgment."

"For the tongue to taste properly, it must be moist, and the substance to be tasted must," according to common opinion, "be liquid.[r] For if either is in a dry state, we may perceive the presence of the substances by the common sense of touch, which the tongue possesses in great acuteness, but cannot discover their sapid qualities." It is by no means proved, however, that the moisture indispensable for taste is requisite to dissolve the substance tasted, and not to fit the papillæ for their office; for moisture is secured to the nerves of every sense.

"When the tongue tastes very acutely, the papillæ around its apex and margins seem to be in some degree erected."

Dr. Nehemiah Grew, in a discourse read before the Royal Society in 1675[s], endeavoured to show that there are at least sixteen different simple tastes, which he enumerates. All these, he avers, have various degrees of intensity and weakness, and may be

[r] "Bellini, *Gustus Organum novissimè deprehensum.* Bonon. 1665. 12mo."

[s] *A discourse of the diversities and causes of tastes, chiefly in plants,* published with all his *Lectures,* by the Royal Society, in one folio volume.

combined together in an innumerable variety of proportions. Many of these have other modifications; "in some the taste is more quickly perceived upon the application of the sapid body, in others more slowly; in some the sensation is more permanent, in others more transient; in some it seems to undulate or return after certain intervals, in others it is constant. All these, and other varieties of tastes, Dr. Grew illustrates by a number of examples."[t] The various parts of the organ, as the lips, the tip of the tongue, the root of the tongue, the fauces, the uvula, and the throat, are some of them chiefly affected by one sapid body, and others by another.

Taste is rendered stronger by pressing the tongue firmly against the sapid substance and moving it. The impression made by a sapid substance is often much influenced by the taste just experienced. The taste of a second substance may be improved or spoiled by the impression of the first: the taste of malt liquor is greatly improved by first tasting cheese. Gall argues against the common opinion, that indulgence deadens the taste, and contends that this renders it more discriminating. He asks if our cooks distinguish sapid articles less perfectly than savages; and if the instances of poisoning among peasants by eating hemlock, belladonna, or poisonous mushrooms, do not prove that their taste is not superior to that of voluptuous citizens? It varies in different persons; at least what is agreeable to one person is disagreeable or indifferent to another; even in regard to mere taste, it is true that "one man's meat is another man's poison." It differs in the sexes, at different ages, and under the influence of habit and of diseases: — men like stronger articles of taste than women; children love sugar more than adults, and dislike fat, which is agreeable to adults; the lower orders enjoy food which would make the higher sick; and chlorotic girls are often fond of mortar and cinders.

Taste is not an unerring index of the wholesomeness of food: for noxious articles are sometimes eaten with pleasure, and wholesome substances disliked.

[t] Dr. Reid, *Inquiry into the Human Mind*, c. 3.

M. M. Guyot and Admyrauld have just published a second memoir in which they illustrate Dr. Grew's remark respecting the effect of different savours on different parts of the gustatory apparatus, and show that its different parts are affected differently by the same sapid body.

When the tongue or interior of the mouth or throat is rather dry, we experience thirst. But, if the dryness is extreme, the nerves may not feel the want of fluid, being apparently disqualified for their office; and merely the roughness of the parts may be complained of. The most intense thirst is felt when the exterior of the tongue and interior of the mouth and throat are covered with a sticky substance: — viscid secretion or jelly will give intense thirst, there being insufficient fluidity and yet no disqualifying aridity.

All animals having a mouth and stomach have probably taste. To disprove a common opinion that birds have but little taste, Gall mentions that Blumenbach finds the organ much larger proportionally in the duck than in the goose; that the palate of many are supplied with very strong and large nervous papillæ; that many birds bruise insects and grains; and many, if different kinds of food are given them, select the most agreeable; that, if whole ants are given to fresh caught nightingales, the birds usually reject them, but if they are bruised they are swallowed with avidity; that those birds which swallow their food whole distinguish different berries and grains with their beak, so that, although all may be taken into the mouth indifferently, the unsuitable are presently rejected; that swans will crush and greedily swallow rats and frogs, but instantly refuse to swallow toads; and that swallows, and all birds that feed on insects, devour bees and large flies, but reject various insects: he reproves M. Duméril for supposing, before the Institute of France, that Nature has supplied fishes with a tongue possessed of a fine membrane, and not given it the sense of taste. Different animals are differently affected by sapid substances: what is disgusting to some is delightful to others; what would make us sick is often a dainty to certain brutes. Gall refutes the absurd opinion of Professor Akerman, that the perfection of man's intellect arises from the perfection of his senses and that man has a finer taste than brutes, by stating that the papillæ of the tongue, pharynx, palate, &c. are proportionally larger and more numerous in brutes; that, to increase the surface of taste, many brutes have the membrane of their palate furrowed and sprinkled with a multitude of nervous papillæ; and that the eating apparatus is in most of them larger than in man; that the dog, bear, and monkey have their tongue covered with as fine a membrane as that of man; and that the enjoyment of taste appears the greatest and most enduring of all in many, as they are eating and ruminating almost constantly while awake. l. c. 4to. vol. 1. p. 151. sqq.

CHAP. XXIV.

SMELL.

" While taste and smell are closely related by the proximity of their organs, they are not less so by the analogy of their stimuli and by some other circumstances. For this reason they have been generally classed together under the name of chemical or subjective senses.

" By smell we perceive odorous effluvia received by inspiration and applied principally to that part of the Schneiderian[a] membrane which invests both sides of the septum narium and the convexities of the turbinated bones.

" Although the same moist membrane lines the nostrils[b] and their sinuses[c], its nature appears different in different parts.

" Near the external openings it is more similar to the skin and beset with sebaceous follicles, from which arise hairs known by the name of vibrissæ.

" On the septum and the turbinated bones it is fungous and abounds in mucous cryptæ.

" In the frontal, sphenoidal, ethmoidal, and maxillary sinuses, it is extremely delicate, and supplied with an infinite number of blood-vessels which exhale an aqueous dew.

[a] " Conr. Vict. Schneider, *De Osse Cribriformi et Sensu ac Organo Odoratus.* Witteb. 1655. 12mo.

This classical work forms an epoch in physiological history, not only because it was the first accurate treatise on the function of smell, but because it put an end to the visionary doctrine of the organ of smell being the emunctory of the brain."

[b] " Sömmerring, *Icones Organorum Humanorum Olfactus.* Francof. 1810. fol."

[c] " Haller, *Icones Anat.* fasc. iv. tab. ii.

Duverney, *Œuvres Anatom.* vol. i. tab. xiv.

Santorini, *Tab. Posthum.* iv.

C. J. M. Langenbeck, *Neue Bibl. für Chirurgie,* vol. ii. P. ii. p. 318. tab. ii."

"It appears the principal, not to say the sole, use of the sinuses[d], to supply this watery fluid, which is perhaps first conveyed to the three meatus of the nostrils and afterwards to the neighbouring parts of the organ of smell, preserving them in that constant state of moisture which is indispensable to the perfection of smell.

"The sinuses are so placed, that, in every position of the head, moisture can pass from one or other of them into the organ of smell.

"The principal seat of smell, — the fungous portion of the nasal membrane, besides numerous blood-vessels, remarkable for being more liable to spontaneous hemorrhage than any others in the body, is supplied by nerves, chiefly the first pair[e], which are distributed on both sides of the septum narium, and also by two branches of the fifth pair. The former appear to be the seat of smell[f]: the latter to serve for the common feeling of the part, that excites sneezing, &c."

The olfactory nerves arise from the pulpy substance at the anterior part of the internal convolutions of the middle lobes,—of course at the base of the cerebrum. The filaments are surrounded a long way with pulpy substance, approach each other, and usually form three roots, which also unite, and where they unite a triangular enlargement is produced: but the nerve soon contracts and runs in a triangular groove at the inferior surface of the anterior lobe on the upper surface of the sphenoid bone. The two nerves converge as they approach the ethmoid, and at last form an oval bulbous expansion, containing a great deal of grey pulpy substance on the cribriform plates. From this soft bulb

[d] "In my *Prolus. de Sinibus Frontal.*, Gotting. 1779. 4to., I have brought forward many arguments from osteogeny, comparative anatomy, and pathological phenomena, to prove that these sinuses contribute indeed to the smell, but little or nothing to voice and speech, as was believed by many physiologists."

[e] "Metzger, *Nervorum Primi Paris Historia.* Argent. 1766. 4to. reprinted in Sandifort's *Thesaurus*, vol. iii.

Scarpa, *Anatomic. Annotat.* l. ii. tab. i. ii."

[f] "This is shown by pathological dissection and comparative anatomy. Thus in Loder's *Observ. Tumoris Scirrhosi in Basi Cranii reperti*, Jen. 1779. 4to. is a case of anosmia, following a compression of the first pair by a scirrhus. We learn, from comparative anatomy, that in the most sagacious mammalia, *v. c.* elephants, bears, dogs, bisulcous ruminants, hedgehogs, &c., the horizontal plate of the cribriform bone is very large, and perforated by an infinity of small canals, each of which contains a filament of the olfactory nerve."

numerous fine branches proceed through the foramina of the bone.

" The extreme filaments of the first pair do not terminate in papillæ, like the nerves of touch and taste, but deliquesce, as it were, into the spongy and regular parenchyma of the nasal membrane.

" The organ of smell is very imperfect and small at birth. The sinuses scarcely exist. Smell consequently takes place but late, — as the internal nostrils are gradually evolved; and it is more acute in proportion to their size and perfection. [g]

" No external sense is so intimately connected with the sensorium and internal senses, nor possess such influence over them, as the sense of smell. [h]

" No other is so liable to idiosyncrasies, nor so powerful in exciting and removing syncope.

" Nor is any other capable of receiving more delicate and delightful impressions; for which reason, Rousseau very aptly called smell, *the sense of imagination.* [i]

[g] " While animals of the most acute smell, as those just mentioned, have the nasal organs most extensively evolved, precisely the same holds in regard to some barbarous nations.

Thus, in the head of the North American Indian (a leader of his nation, and executed at Philadelphia about fifty years ago), which I have given in my *Decas prima Collectionis Craniorum diversarum Gentium illustratæ,* tab. ix., the internal nares are of an extraordinary size, so that the middle of the ossa spongiosa, for example, are inflated into immense bullæ, and the sinuses, first described by Santorini, which are contained in them, larger than I have found them in any other instance.

The nearest to these, in point of magnitude, are the internal nares of the Ethiopians, from among whom I have eight heads, now before me, very different from each other, but each possessing a nasal organ much larger than we find it described to be in that nation by Sömmerring, *über die körperl. Verschiedenh. des Negers,* &c. p. 22.

These anatomical observations accord with the accounts given by most respectable travellers concerning the wonderful acuteness of smell possessed by those savages.

Respecting, *v. c.* the North American Indians, consult, among others, Urlsperger, *Nachr. von der Grossbritann. Colonie Salzburg. Emigranten in America,* vol. i. p. 862.

Respecting the Ethiopians, *Journal des Sçavans.* 1667. p. 60."

[h] " See Alibert on the medical power of odours, *Mém. de la Soc. Médicale,* t. i. p. 44."

[i] " *Emile,* t. i. p. 367."

"No sensations can be remembered in so lively a manner as those which are recalled by peculiar odours." [k]

Haller mentions that less than the two billionth part of a grain of camphor has been distinctly odorous. [l]

The causes of the sensation of smelling are, as yet, unknown, and in the absence of positive knowledge on this subject philosophers have either avowed their ignorance or contented themselves with hypotheses destitute of proof. Among the opinions respecting these recondite phenomena which have at various times been advanced, three may merit our consideration. The advocates of the first designate by *spiritus rector*, or *aroma*, a principle independent of the substances which contain it, very volatile and expansible, imponderable, and imperceptible to every sense excepting that of smell: and to the various modifications of this immaterial substance they attribute the varieties of odour. The second, and most generally received theory, is that odours are particles which evaporate from the odorous substance itself, and that the cause of the sensation of smell is therefore inherent in, and inseparable from, the odorous body. The third opinion, which is maintained by Professor Walther, is, that olfaction is independent of the emanations of material particles and is a simple dynamic action of the odorous body upon the organs of smelling, similar to the action of sound on the hearing.

However this may be, odours, to become objects of sensation, must pass the pituitary expansion of the olfactory nerve during the respiratory process. When the breath is held, the most odorous substances may be spread in the interior of the nostrils without their perfume being perceived; this observation was first made by Galen. It has been frequently remarked that odours are smelt only during inspiration, the same air when returned through the nostrils always proving inodorous. But this is true only when the odour has been admitted from without by the nostrils, for, when it is admitted by the mouth, as in combination with articles of nutrition, it can be perceived only during *expiration*. A proof of this may be readily obtained by placing the open neck of a small phial, containing an essential oil, in

[k] "Respecting the power of smell over morals and propensities, consult Benj. Rush, *Medical Inquiries and Observations*, vol. ii. p. 34."

[l] *El Physiol.*, vol. v. p. 157.

the mouth during the acts of inspiration and subsequent expiration.

It was first observed by Willis [m] that, on placing a sapid substance in the mouth, and at the same time closing the nostrils, the sensation of taste is suspended. This observation has since been frequently repeated, and has given rise to the generally prevailing opinion that a very intimate relation exists between the sensations of smelling and tasting, and that the same qualities of bodies simultaneously affect both these senses. The fact is that the causes of taste and smell are totally distinct in their nature. Tastes, properly so called, affect only the gustatory expansion, and are, consequently, unaltered by closing the nostrils; but, as most sapid substances have also an odour, and expiration takes place frequently during mastication and generally directly after deglutition, the odorous emanations are made to pass over the pituitary membrane. Odour, which thus accompanies taste, is termed *flavour*.

Sugar, salt, and vinegar, have each a real taste, which can be affected neither by catarrh, palsy of the olfactory nerves, nor by stopping the nostrils; but the flavour and odour of roast meats, of spices, of liqueurs, &c., are identical, and they are affected equally by the same conditions.

Dr. Prout, I believe, was the first who pointed out the distinction between taste and flavour.[n] He conceived, however, that flavour was intermediate between taste and smell.

I have seen instances of the loss of smell from a fall on the head, and other violent causes. Whatever had no odour could be tasted as usual: but the mechanical and pungent qualities only of simply odorous bodies habitually taken into the mouth could be perceived; and bodies both odorous and sapid were tasted only, and therefore but imperfectly judged of.[o]

Some tribes of uncivilised men far surpass us in the power of smell. The American Indians have distinguished men of different nations by this sense. Dogs readily distinguish individuals by its means, and in many brutes of prey it is very powerful.

[m] *De anima brutorum.* By Thos. Willis, M. D. 1672.

[n] *London Med. and Physical Journal.* 1812.

[o] I was consulted by a tea-broker who lost his smell from a fall on his head, and could no longer judge of teas. He went through the form of tasting teas at the East India House, that his inability might not be suspected, but he was totally insensible to their flavour. He tasted salt and sugar as well as ever.

Angelo Poliziano says that after a battle a flock of famished vultures arrived the next day from a distance of 166 leagues to devour the bodies. But Mr. Audubon relates two experiments to show that vultures are indebted to acuteness of sight rather than of smell. He stuffed a deer's skin with hay, allowed it to become as dry as leather, and placed it in a field: in a few minutes a vulture made for it, attacked it, tore open the stitches, and pulled out the hay. He then put a large dead hog into a ravine, and concealed it with cane; it putrefied and gave forth an intolerable stench, but the vultures which were sailing about in all directions in search of food never discovered it, although several dogs had been attracted and had fed plentifully on it. He next stuck a young pig and covered it closely with leaves: vultures soon saw the blood, descended to it, and by its means discovered the pig, which they devoured while still fresh.

Whenever smell is naturally powerful, the organ and olfactory nerves are greatly developed. In disease it may become surprisingly acute. T. Bartholin mentions an individual, labouring under dropsy, who could name the individuals in the next room by smell.[p] The boy Mitchel, deaf and blind from his birth, is described by Mr. Wardrop as having, probably from great use and attention, so powerful a sense of smell, that, "when a stranger approached him, he eagerly began to touch some part of his body, commonly taking hold of the arm, which he held near his nose, and after two or three strong inspirations, appeared to form a sudden opinion regarding him. If this was favourable, he showed a disposition to become more intimate, examined more minutely his dress, and expressed by his countenance more or less satisfaction: but, if it happened to be unfavourable, he suddenly went off to a distance, with expressions of carelessness or of disgust."[q]

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[p] *Acta Hafniensia.* However, in the same work (vol. i.) it is related by a Dr. Marcus Marci, on his own testimony, that a priest at Prague could distinguish incorrect from correct ladies by his nose. Yet this was not worse than the declaration in London, a few years ago, of a once extensively employed insanity doctor, that he could distinguish madmen by his nose, — that madmen do not smell like other people.

[q] *History of James Mitchel, &c.* By James Wardrop. London, 1813.

All animals exposed to the air have perhaps the sense of smell. Its seat has been referred in the air-breathing annelides and insects to the mouths or lateral pores of the air sacs; or in the latter "to the delicate extremities of their long flexible antennæ, and the inner pair of those organs in the crustacea have been considered as the seat of the same sense. The labial appendices of the conchifera, the entrance to the respiratory sacs of pulmonated gasteropods, the highly sensitive tentacula covered with a delicate mucous membrane, and even the whole surface of the skin in the more elevated molluscous classes, have been considered as the organs through which these animals receive impressions from odorous emanations. In the class of fishes, we observe the organ of smell to be only a depression excavated on the anterior part of the face, but it does not communicate behind with the mouth, or the respiratory organs, or the interior of the body." "By the motions of fishes through the water they are sufficiently exposed to receive impressions of odorous substances diffused through that medium, without drawing dense water through those delicate organs for the purposes of smell. Perhaps the volumes of water necessary to be carried continually through the mouth of fishes for respiration are too great, and would prove too powerful a stimulus to have passed through such an organ of smell, and to have allowed that organ to preserve its necessary delicacy, and therefore it is quite apart from the passage through which that element is taken for respiration in all water-breathing animals. It is, obviously, however, in fishes an organ of great delicacy and importance, and is of great size, provided with very large olfactory nerves, and large olfactory tubercles, coming off alone from the hemispheres of the brain." "In the amphibious animals, where the respiration of air begins to take place through the nostrils, the olfactory apparatus begins to be more complicated and concealed." In fish a plate of cartilage sometimes divided the impervious olfactory cavity into two: in the amphibia this "begins to assume now the more compact and convoluted form which the osseous plates in the higher animals present. The surface of the organ thus increases in extent, as we ascend through the reptiles and through the birds to the mammalia. In the perenni-branchiate amphibia the nostrils form still on each side a simple sac, scarcely complicated internally, and having their posterior opening so far formed in the mouth as to be immediately under the upper lip. In the salamanders and frogs the nostrils are still, in the larva state, confined to the exterior of the head, as in fishes; but in the adult form, the posterior openings, though within the cavity of the mouth, are still much advanced in their position, and remote from the median line." "In the serpents the internal surface is extended by the rudimentary turbinated bones, and by an enlarged nasal cavity, opening posteriorly by a common orifice on the median line." "In the sauria the turbinated bones begin to be strengthened by ossific matter and to assume a more complicated form: both the anterior and posterior openings of the nares present enlarged dimensions, and the whole organ is more internal and more protected by the expanded nasal bones. The organs of smell are more protected and concealed in the solid head of the chelonian reptiles, where their surface is increased in extent and their posterior openings are placed further back from their primitive anterior aspect. The anterior openings of the nostrils are here

very small. The olfactory nerves, and the whole organs of smell, are small in birds. The anterior openings are large and oblique for respiration during their rapid movements, and the various forms and positions of these apertures present useful characters for the distinction of species. The turbinated bones are larger than in reptiles, though still but partially ossified, and the olfactory nerves pass through the orbits into the nose. The defective development of this organ is compensated for in some by the extensive distribution of its fifth or trifacial nerves, on the upper and lower jaws, and in most by the great development of the organs of vision. All the internal parts of the organs of smell become more complex and elaborate in quadrupeds, new cavities open into their interior, as the frontal, maxillary, and frontal sinuses, and the exterior nares assume a more lengthened and expanded form. Most of these animals we observe to have all the nasal cancellated bones of great size and presenting an immense surface, both on the ethmoid and turbinated bones, for the distribution of the olfactory nerves, and we perceive in them a corresponding increase of power in their sense of smell." (Dr. Grant's *Lectures. Lancet*, No. 569.) Gall refuted the assertion of Cuvier and others, that carnivorous brutes have a more acute smell and larger olfactory nerves than the herbivorous; and thus replies to M. Duméril's opinion of odours not being transmissible by water, and of the organ of touch occupying that of smell in the cetacea. "Nature then has made a mistake in placing one of the special organs of animals that live in water, and amused herself with this prank when she formed otters, seals, and all fish, and henceforth all attempts to catch fish and crabs with odorous bait will be fruitless." l. c. 4to. vol. i, p. 158. sq.

CHAP. XXV.

HEARING.

By Hearing we are able to appreciate the vibratory motions of elastic bodies, when their frequency is within certain limits. Some experiments by Dr. Wollaston prove that these limits vary in different individuals; but the average extent of the scale of sounds perceptible to the human ear has been estimated to be between 30 and 12,000 vibrations of the sonorous body per second.

The undulations to which these vibrations give rise may be transmitted through any substance, either aëriform, liquid, or solid: but the air is the ordinary medium by which they reach the ear. The velocity of transmission depends on the specific elasticity of the substance; according to the latest experiments, sound travels through air at the rate of about 1142 feet per second.

With regard to the sensation of sound, three independent qualities must be distinguished: [a]

1st. The *tune*, or *pitch*; which depends on the frequency with which the vibrations succeed each other.

2d. The *loudness*, or *intensity*; which is determined by the amplitudes of the vibrations.

3d. The *timbre:* — For this word, adopted in France to express the specific differences of sound which are not comprehended in any of the preceding definitions, there is no analogous term in our language; nor have we at present the least idea of the true causes of these modifications of sound. In some cases the indefinite expression *quality of tone* is employed.

When two or more sounds are heard simultaneously, or successively, the mind by a peculiar faculty perceives the relative fre-

[a] C. Wheatstone, *Experiments on Sound. Annals of Philosophy.* New Series, vol. vi. p. 81.

quency and coincidences of the vibrations. Two sounds are regarded as consonant, when the ratio of their vibrations is very simple; and as dissonant, when the ratio is more complex. The rules which determine the most agreeable successions and combinations of sounds constitute the science of music.

The power of appreciating musical combinations, and consequently the pleasure of listening to them, depends upon a mental faculty seated in a particular portion of the brain, and not upon the acuteness of hearing. A person of the quickest ears may have no music in his soul, and persons of dull ears have often a good *ear for music.* Many authors have ascribed perception of the musical qualities of sounds to the ear, although there is no relation between acuteness of hearing and musical talents. The ear merely presents the sounds, an inward sense perceives their musical qualities. This inward sense resides in a particular portion of the brain, and is proportionate to the perfection of its organisation and size. In all the cases, which I have examined, of flatness or depression of the part of the forehead corresponding to this, the perception of music has been defective; and, in all instances of good musical talent, this part has been full or prominent. The examination of singing birds proves the same thing. Others have with equal absurdity ascribed the idiotism of some persons born deaf to their defect of hearing. Persons may be both idiotic and deaf: but the defect of intellect depends upon the defect of the superior anterior parts of the brain, in quality or quantity.[b]

The organs of hearing are situated at the two sides of the head, in a portion of the temporal bone, which is considered the hardest in the human body. The parts which constitute these organs are the external ear, the meatus auditorius, the tympanum, and the labyrinth.[c] The last named part is, there can be little doubt, the seat of sensation, and the other parts serve only to communicate to the labyrinth the impressions from the sonorous agitations of the air.

The *external ear*[d] is a shell-formed cartilage having various elevations and depressions. This appears destined to collect and

[b] On both these errors, see Gall, l. c. 4to. vol. i. 161. sqq. See also l. c. 8vo. t. v. p. 96. sqq.

[c] "Sömmerring, *Icones Organor. Humanor. Auditus.* Francof. 1806. fol."

[d] "B. S. Albinus, *Annotat. Academ.* l. vi. tab. iv."

reinforce the sound. It is furnished with several muscles for the purpose of changing its form; but few individuals have the power of using them. It is generally supposed that the habit has been lost in most persons from the earliest infancy, on account of the pressure of the coverings of the head. Be this as it may, some persons preserve the power of controlling these muscles, and I have myself seen an individual in whom the motions arising from their action were perfectly voluntary.[e]

The *meatus auditorius* is partly cartilaginous and partly bony. It is lined by a bitter cerumen.[f] The external ear becomes tubular, and thus continues to the osseous part, where it is terminated by the *membrane of the tympanum*, the office of which is to receive impressions from the agitations of the air, in order to transmit them to the internal ear.[g] The membrane of the tympanum is of an irregular conical form, something like a Chinese hat; its concavity is on the outside, and its projecting point on the inside. It is fixed to a bony rim which is called its frame.

The cavity of the *tympanum* occupies the space between the membrane and the labyrinth. It is an irregular cavity, nearly hemispherical; it is filled with air and communicates with the back part of the mouth by means of a canal called the *Eustachian tube*.[h] The side which is opposite the membrane presents an ob-

[e] "V. J. Rhodius ad Scribon. Largum. p. 44. sq.
J. Alb. Fabricius, *De Hominibus ortu non differentibus.* Opuscul. p. 441.
Ch. Collignon, *Miscellaneous Works.* Cambridge. 1786. 4to. p. 25. sq."

[f] "Consult J. Haygarth, *Med. Obs. and Inquiries,* vol. iv. p. 198. sq."

The cerumen consists, according to Vauquelin, of albumen, which, when burnt, yields soda and phosphate of lime, a colouring matter, and a very bitter inspissated oil strongly resembling the peculiar matter of bile. Cicero explains one use of the cerumen:—"Provisum etiam, ut, si qua minima bestiola conaretur irrumpere, in sordibus aurium, tanquam in visco, inhæresceret." (*De Natura Deorum,* l. ii.) The same applies to particles of dust. Its extreme bitterness, too, deters insects from advancing.

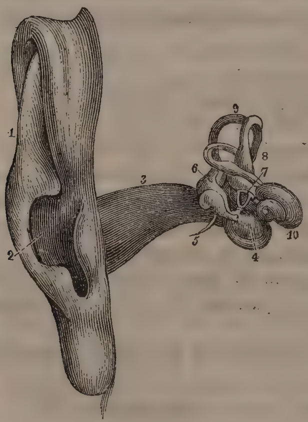
[g] "See the distinguished Himly's acute comparison of the organs of hearing and vision, *Bibliothek für Opthalmologie,* vol. i. p. 6. sqq."

[h] "Saunders, *Anatomy of the Human Ear.* Lond. 1806. fol. tab. i. ii."

"Comparative anatomy renders it most probable that the Eustachian tube is subservient to the action of the membrana tympani. It is found in all red-blooded animals which possess a membrana tympani, but is wanting in fishes which are destitute of this membrane. The different opinions of the moderns respecting its use may be found in Reil's *Archiv für die Physiol.* t. ii. p. 18., iii. p. 165., iv. p. 105., viii. p. 67., ix. p. 320."

lique projection, called the promontory; above this projection there is an opening of the labyrinth called the *fenestra rotunda*[i], and which is shut by a membrane; below, there is another aperture of the labyrinth, the *fenestra ovalis*, where the impressions of the vibrations upon the membrana tympani are communicated to the labyrinth, by a very flexible intermediate apparatus, consisting of a chain of *four small bones*[k], —the malleus or hammer, the incus or anvil, the lenticular bone, and the stapes or stirrup.

The *hammer* consists of a long and thin handle, the extremity of which adheres to the membrane of the tympanum; and of a head, which forms an angle with the handle and is articulated with the anvil. It is united to the bony rim of the membrane by its spinous process, which may be regarded as the fixed point of the lever. The *anvil* is on one side articulated with the head of the hammer; and the opposite part has two processes, one of which serves as a resting point, and the other is articulated by means of the *lenticular bone* with the stirrup. The *stirrup*, which is so called from its close resemblance in form to that object, makes almost a right angle with the anvil, and its moveable base closes the fenestris ovalis of the labyrinth, the interior of which it agitates



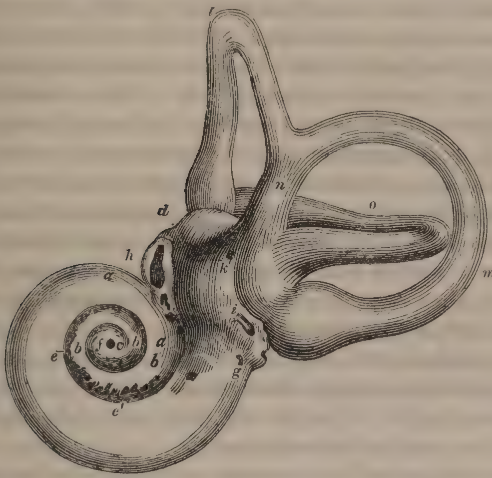
1. External ear.
2. A part of it called concha; and orifice of the meatus externus.
3. Meatus externus.
4. Membrana tympani.
5. Malleus.
6. Incus.
7. Stapes and os lenticulare.
8. Vestibule.
9. Three semicircular canals.
10. Cochlea.

[i] "Scarpa, *De Structura Fenestræ Rotundæ*, &c. Mutin. 1772. 8vo."

[k] "The existence of a fourth bone (called *lenticular*), commonly admitted since the time of Franc. Sylvius, I have disproved at large in my *Osteology*, p. 155. sq. edit. 2. It is wanting in the greater number of perfect examples from adults."

by its pressure. The hammer is provided with three muscles the stirrup only with one, and the anvil has none.[l]

There can be no doubt that the use of this apparatus is to enable us to hear more perfectly: but there are instances in which the hearing has remained after the destruction of these organs. Sir A. Cooper has recorded such cases [m]; and deafness has even been suspended, for a short time, by perforating the membrana tympani. In these cases the sound appears to be transmitted to the laby-



a a a, first turn or gyration of the cochlea.
b b b, second turn.
c, third turn.
d, very short canals for the entrance of nerves.
e e, other holes for the passage of nerves and blood-vessels to the internal ears.
f, canal in the base of the cochlea for the passage of a nervous twig to the infundibulum.
g, portion of the aqueduct of the cochlea.
h, canal for the passage of the nerves of the elliptic vesicles of the superior vertical and horizontal semicircular canal.
i, opening for the passage of the nerves of the inferior semicircular canal, and the nervous flabelliform expansion.
k, aqueduct of the vestibule.
l, superior vertical semicircular canal.
n, inferior vertical semicircular canal.
u, canal produced by the junction of the two vertical semicircular canals.
o, horizontal semicircular canal.

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[l] "B. S. Albinus, *Tabulæ Muscul.* tab. xi. fig. 29."
[m] *Phil. Trans.* 1800.

rinth by the immediate action of the air upon the membrane of the fenestra rotunda, which Scarpa calls the secondary membrane of the tympanum.

The *labyrinth*, so called on account of its complicated canals, s the internal part of the organs of hearing, and is hewn out of the hardest portion of the temporal bone. It contains the substance of the auditory nerves, variously spread as layers and fibres in a gelatinous water. Its parts are the three semicircular canals, the vestibule, and the cochlea.

The *semicircular canals*, two of which are vertical, and the third nearly horizontal, contain similar membranous canals, each of which has a swelling at its extremity. These canals terminate by their extremities in the vestibule or central cavity. The cochlea, in part osseous and partly membranous, winds round a conical axis, in a spiral which makes two turns and a half and which diminishes so that the cochlea approaches to the globular form. One of its two gyrations terminates at the fenestra rotunda, which communicates with the cavity of the tympanum; the other proceeds to the vestibule, which itself communicates with the same cavity by means of the fenestra ovalis.

"The vestibule and semicircular canals loosely contain very delicate membranous bags, discovered by the celebrated Scarpa: viz., two sacs which lie in the vestibule, and three semicircular ducts in the canals of the same name.[n]

"These sacs, as well as the cavity of the cochlea, contain a very limpid fluid, bearing the name of Cotugno, who showed it to be absorbed by two canals, which are by him denominated *aqueducts*[o], and by Meckel *diverticula*[p]: the one arises from the vestibule, the other from the inferior scala of the cochlea.

"The portio mollis of the seventh" pair or acoustic nerve arises from the fore-part of the floor of the fourth ventricle, is at first soft, but soon becomes firmer and more fibrous, and, "having, together with the portio dura (which afterwards runs along the *aqueduct* of Fallopius[q]), entered the internal acoustic opening, transmits its medullary filaments into the lower and cribriform

[n] "Scarpa, *Disquisitiones Anatomicæ de Auditu et Olfactu*, tab. iv. fig. 5. tab. vii. fig. 3."

[o] "Cotunni, *De Aquæductibus auris humanæ*. Neap. 1761. 4to."

[p] "Ph. Fr. Meckel, *De Labyrinthi auris contentis*. Argent. 1777. 4to."

[q] "Fallopius, *Observ. Anat.* p. 27. b. sq. Venet. 1561. 8vo."

part of it.[r] These filaments run partly to the vestibule and semicircular canals, but especially to the base of the cochlea, where, in the form of a medullary zonula, marked by very elegant plexiform striæ, they pass between the two laminæ of the septum cochleæ [s]," forming according to Mr. Swan, a net-work, and beautifully terminating in a still more fibrous expansion than the optic nerve.

The facial nerve enters the internal auditory canal in company with the acoustic, which it leaves, and passes through the aqueduct of Fallopius to come out at the foramen stylo-mastoideum. In the aqueduct it gives a filament to the little muscles within the ear. The posterior branch or Vidian nerve of the superior maxillary of the trigeminum, after entering the aqueduct of Fallopius and lying in contact, but not anatomosing with, the facial, gives off a nerve which traverses the tympanum under the name of chorda tympani, and leaves the cranium at the glenoidal fissure. Thus the ear, like the eye and the tongue, has nerves of special sense, of simple sensibility, and of motion.

Notwithstanding the scrupulous examination of the construction of the organs of hearing by anatomists, very little that is certain is known with regard to the uses of the various parts. It is true that many theories have been advanced, but they have for the most part been founded upon analogies which in the present state of acoustic science will not bear investigation.

The hypotheses of M. Savart, which have in general been suggested by accurate experiments, are the most rational which have hitherto been proposed, and the following are the conclusions at which he has arrived from his experiments.

1st. That it is not necessary to suppose, as hitherto has been done, the existence of a peculiar mechanism to bring the membrane of the tympanum continually in unison with the sonorous bodies which act upon it; since it is obviously always in those conditions which render it capable of being influenced by any number of vibrations whatever. 2dly. That its tension probably only varies to augment or diminish the amplitude of its excursions, as Bichat had conjectured: this eminent physiologist,

[r] "Consult Brendel, *Analecta de Concha auris humanæ*. Gotting. 1747. 4to. The same, *De Auditu in apice conchæ*, Ib. eod. 4to."

[s] "Consult Zinn, *Observ. Botan.* Gotting. 1753. 4to. p. 31. sq. Scarpa, l. c. tab. viii. fig. 1, 2."

however, supposed that it was stretched for intense impressions, and relaxed for the weaker, which is contrary to what is demonstrated by experiment. 3dly. That its vibrations are communicated without alteration to the labyrinth by means of the chain of small bones, in the same manner as the vibrations of the belly of a violin are communicated to the back by means of the sound post. 4thly. That the small bones have also for their function to modify the amplitude of the excursions of the vibrating parts of the organs contained within the labyrinth. And lastly, That the cavity of the tympanum probably serves to maintain, near the openings of the labyrinth and the internal surface of the membrana tympani, an air the physical properties of which are constant.

Weber has endeavoured to explain the use of the cochlea. He remarks that sound is propagated through, not only the meatus auditorius externus, but the bones of the head; and, indeed, more distinctly through them. If both ears are stopped firmly with the fingers, our own voice becomes more loud and distinct. If we remove one finger immediately, we hear our own voice stronger with the other ear. If a musical sounding fork under vibration is placed between the teeth, the lips closed and both ears stopped, its tones are heard louder than if the ears were open: open one ear, and the sound is lessened to that ear. If the fork is applied to the left temple and the right ear only closed, the sound is louder to the right ear than to the left which is open. Now sounds propagated through one uniform medium, fluid or solid, lose but little of their force; whereas in passing from one medium to another, as from a fluid to a solid or *vice versâ,* they lose much of their force. In the shaft of a mine the sound of a hammer in a neighbouring shaft is heard very well if the ear is placed in contact with the rock; if this is not done it is heard less, and the sound of voices in the other shaft not at all. Sounds transmitted through water may be heard at great distances if the head is under water; and are inaudible as soon as the head emerges. The effect of a window in lessening the noises of the street is a similar instance Now the sonorous vibrations which pass from the air through the bones of the head to the internal ear will act on the cochlea, because it is the nearest and has its share of the acoustic nerve in intimate contact with itself, and is both osseous and forms a portion of the osseous communication between the mouth and the internal

ear. The vibrations proceeding from the air within the mouth cannot be transmitted so easily to the branches of the acoustic nerve distributed to the vestibule and semicircular canals, because these, spread out as a sacculated and tubular membrane, are studiously separated from the bones by a liquid secretion or loose cellular membrane. Weber therefore concludes that the cochlea is intended to place the extremities of the acoustic nerve in connection with a vibrating solid. On the other hand, he concludes that the use of the semicircular canals is to be in connection with a vibrating fluid and receive the impulses of the air through the meatus auditorius. Because, 1. the vestibule and semicircular canals have a solid communication by the chain of bones with the membrana tympani, whose vibrations are at once imparted by them to the membrana of the fenestra ovalis; whereas there is no such direct communication between the membrana tympani and the fenestra rotunda. 2. The membrane of the semicircular canals and vestibule seem more easily thrown into vibrations by the fluid around them than the lamina spiralis of the cochlea. The latter also, however, is enabled to receive impulses from the air, by the membrane of the fenestra rotunda communicating the vibrations which occur in the tympanum, and by the opening of the cochlea into the vestibule causing the vibrations of the fluid of the vestibule to be at once propagated to the cochlea.

Weber states that Scarpa was the first to discover the remarkable difference in consistence and texture which exists between that portion of the acoustic nerve which supplies the cochlea, and that which is distributed to the vestibule and semicircular canals. The latter, surrounded on all sides by a fluid, are soft and pulpy, evidently fitted to receive impulses from a fluid: the former, on the contrary, fine and ramified, as evidently adapted to the reception of vibrations from a solid.

I must state that Professor Wheatstone above ten years ago made experiments similar to those of Weber and with the same results.[t] His views respecting the functions of the semicircular canals differ from those advanced by Weber. He maintains that

[t] See his Experiments on Audition in the *Journal of Science*, New Series, vol. ii. p. 67. 1827. Some curious and original observations and experiments will be found in a paper by Dr. Wollaston, *Phil. Trans.* 1820; and some interesting facts in Savart's *Memoir*.

sounds are transmitted to the internal organs of hearing in two manners; first, in the manner ordinarily understood, and secondly by the solid part of the head.

The perception that we have of the direction of sounds he supposes to arise solely from the portion which is transmitted through the solid parts of the head, and which, affecting the three semicircular canals, situated in planes at right angles with each other, with different degrees of intensity according to the direction in which the sound is transmitted, suggests to the mind the corresponding direction. If the sound is transmitted in the plane of either of the semicircular canals, the nervous matter in that canal will be more strongly acted on than that in either of the other two; and if it be transmitted in any plane intermediate between any two of the rectangular planes, the relative intensities in these two canals corresponding therewith will vary with the direction of the intermediate plane. The ordinary notion respecting our perception of the direction of sound is that we compare the relative intensity of the sensation in the two ears, and thus judge of its direction. Were this true, a sound produced any where in the prolongation of the mesial plane, whether before, behind, or above the head, should suggest no difference of direction; whereas we know from experience the contrary to be the case. The views of Professor Wheatstone were first announced in Mr. Mayo's lectures at the College of Surgeons.

As most of the lower invertebrate animals live in water, the percussions of which must powerfully effect their surface, naturalists do not find a special organ for hearing among them, till they ascend as high as the air-breathing insects. In these it is more complicated than in any other invertebrata, for many of them emit sounds intended to be heard by their kind. Some have hard instruments for this purpose which they rub against each other, and thus the male and female correspond in the dark for their amours. Insects have not only the first elements of an ear, — the auditory nerve and vestibule, but the rudiments of two semicircular canals: fluid exists within, and the vestibule has a fenestra ovalis covered with a thin membrane. But in the aquatic invertebrata, as the lobster, cray-fish, and crab, the nerve and vestibule with its fenestra ovalis and membrane only are found. In those which have long tails and swim briskly, like the two former, the membrane is delicate and vibratile, whereas in those

which move slowly and have all their organs of sense dull, like the latter, it is dense, and in the crab distinctly ossified. The fixed and slow moving mollusca, as the oyster, barnacle, muscle, slug, snail, have dull senses in general; and their organ of hearing has not been detected, but some appear to hear, and one, — the tritonia arborescens, emits audible sounds, intended no doubt to be heard by its own kind. The cephalopods, however, as the cuttle-fish and nautilus, approaching to fishes in complexity of structure, quickness of motion, and acuteness of sight, have also a higher development of the organ of hearing. We first find a calcareous substance in the fluid of the vestibule, acting probably like the clapper of a bell. "In passing up through the vertebrated classes, we observe the organ gradually developing the semicircular canals and cochlea, and becoming enveloped in the solid parietes of the cranium; it acquires a tympanic cavity communicating with the fauces by the Eustachian tube, and containing the ossicula auditus, which convey the vibrations of the membrana tympani to the vestibule and the whole internal labyrinth; and in the highest forms of the organ a still more exterior meatus auditorius, and complicated moveable concha are added to complete the instrument." Thus, although in the lowest cyclostome or cartilaginous fishes, as the lamprey, the ear is of no higher order than in the cephalepodous mollusca, without canals or calcareous substance, the osseous fishes have calcareous bodies in the vestibule, and large semicircular canals ending in considerable ampullæ. Still the organ is in the common cranial cavity, and not enclosed in the temporal bone, nor are there usually a meatus and external opening. In the large cartilaginous fishes, as the sturgeon and the rays, the ear is imbedded in the cartilaginous temporal bone: in the former the semicircular canals only, the vestibule being still in the cranial cavity; in the latter the whole: and the vestibule has sacs which are the rudiments of a cochlea. The lowest reptiles resident in water, — the perenni-branchiate species, as the newt, have ears like those of fishes, and sounds are equally communicated through the solid walls only of their cranium. The same structure exists in the larva of the caducibranchiate, as tadpoles; but, when the animal loses its gills and becomes a frog, the semicircular canals are imbedded in a distinct cavity of the temporal bone, a tympanum, Eustachian tube, and three soft ossicula united are seen, and the skin forms a membrana tympani on a level with the surface of the head. In the serpents the ear is much the same. In the saurian reptiles the tympanum is much larger. In the crocodile there is an appendage like a rudiment of a cochlea, and on the margin of the membrana tympani two folds of skin, like eyelids, are found, which appear like the rudiments of a concha. In the chelonia, as the tortoise, the tympanum and united bones are of greater length, and a cochlea is more distinctly developed. In birds, the organ is greatly advanced, and large in proportion to the head. It is completely enveloped in bone of rocky hardness; the semicircular canals are smaller than in fishes, but with larger ampullæ; the vestibule is lengthened; the cochlea begins to assume a spiral form, though it still has a remnant of the calcareous bodies found in the labyrinth of fishes; the tympanum is lengthened, and numerous cranial cells communicate with it; a short meatus externus appears; and in nocturnal predaceous birds, which much require the sense of hearing, a high crescentic fold of skin is found at the upper

and back part,—as a rudimentary concha; and the feathers are so arranged around as to serve the purpose of a concha: and this feature is very characteristic in owls. In mammalia all the parts acquire their full development. The cochlea, the size of which bears a pretty constant proportion to the acuteness of hearing, is greatly developed, turbinated, and divided: the ampullæ are often small: the ossicula are first completely developed, are articulated, and supplied with muscles: the Eustachian tube is lengthened; so likewise is the meatus externus, and provided with hairs and a disagreeable secretion for defence; and the concha, the size and mobility of which indicate acute hearing, is developed in this class only, though frequently small or absent in the inferior species and the aquatic, as whales, beavers, and seals. In the timid, which are to be pursued, both it and the meatus are directed backwards; in the predaceous, which are to pursue, forwards: in the former too it is large, and the brain is small; in the latter small, and the brain is large: in the quadrumana, and especially in the oran-outang, it becomes short, round, and motionless as in us. In the aquatic mammalia, in order to prevent the entrance of water, the meatus is narrow and winding, and the orifice very small; and in quadrupeds which dive or burrow, a double membrane is provided, which can accurately close it. The hippopotamus, which feeds at the bottom of rivers, has an apparatus for the same purpose. (See Dr. Grant, *Lancet*, No. 569., and *Outlines of Comparative Anatomy*. Dr. Roget, *Bridgewater Treatise*.)

Many animals surpass us in acuteness of hearing. The common birds about us hear the faintest sound. "Not only," says Gall, "are the vestibule and semicircular canals proportionally larger in many brutes, but the acoustic nerve and all its apparatus are more perfect. This nerve originates in a more considerable mass of grey substance, and is consequently considerably larger, as any one will find in the sheep, ox, horse, &c. The external concha is much more developed in most brutes, and the great osseous cavities surrounding the labyrinth in many produce a similar effect in augmenting the sound of the solid and elastic vaults. These cavities, which must not be confounded with the mastoid processes, contain, in many brutes, for instance, in the calf, concentric canals which unite into a common cavity, and must evidently increase the sound." (l. c. 4to. vol. i. p. 161.)

CHAP. XXVI.

SIGHT.

"THE instruments of vision, — the eyes[a], are two moveable globes, fixed to the optic nerves, whose decussation we formerly noticed, as it were to stalks, in such a manner that their insertion is not exactly opposite the centre of the cornea and iris, but on one side of this imaginary axis, — rather nearer to the nose.

"They consist of various coats containing pellucid humours of different densities, so placed that the rays of light can pass from the transparent anterior segment of the bulb to the opposite part of the fundus.

"The external coat is called *sclerotic*. It is deficient in the centre, and that part is filled up by the *cornea*, which is transparent, lamellated (lined internally by the *membrane of the aqueous humour*, or of Demours), more or less convex, and projects like the segment of a small globe from one of rather larger size.[b]

"The interior of the sclerotic is lined by the *chorioid*, which abounds in blood-vessels[c], especially vorticose veins, and is covered on each side by a black pigment, which adheres but loosely to its concave surface in the form of mucus.[d]

[a] "Sam. Th. Sömmerring (the father), *Icones oculi humani.* Francof. 1801. fol.

Detm. W. Sömmerring (the son), *De oculorum sectione horizontali Commentarius.* Gotting. 1818. fol."

[b] "G. H. Gerson, *De forma corneæ deque singulari visus phænomeno.* Gotting. 1810. 4to.

Al. Clemens, *Tunicæ corneæ et humoris aquei monographia.* Gotting. 1816. 4to.

M. J. Chelius, *Ueber die durchsichtige Hornhaut.* Carlsr. 1818. 8vo."

[c] "Sam. Th. Von Sömmerring, in the *Denkschr. der Akad. der Wiss. zu München.* 1817. tab. 1."

[d] "C. Mundini, in the *Comm. Instit. Bononiens.* t. vii. p. 29.

H. F. Elsaesser (præs. G. C. Ch. Storr), *De pigmento oculi nigro.* Tubing. 1800. 8vo."

"The chorioid is internally coated by the *retina*[e] — an expansion of the optic nerve after this has passed through the sclerotic and chorioid[f], of most beautiful texture[g], and perforated, in the imaginary axis of the eye, between the two principal twigs of the central artery[h], by the singular central foramen of Sömmerring[i], which is surrounded by a yellow edge."[k]

A delicate transparent membrane has been discovered by Dr. Jacob of Dublin between the retina and chorioid, and adherent to both.[1]

"The anterior edge of the chorioid is terminated by a cellular belt, called *orbiculus ciliaris*, by which it adheres firmly to a corresponding groove in the sclerotic, and from which two other membranes of a different kind, viz. the iris and ciliary processes, are expanded in a circular form.

[e] "B. S. Albinus, *Annotat. Academ.* l. iii. p. 59. sq. l. iv. p. 75. sq. l. v. p. 66. sq."

[f] "Walter, *De venis oculi*, &c. Berol. 1778. 4to. tab. i. fig. 2. tab. ii. fig. 2."

[g] "The extremely beautiful blood-vessels of the retina were first discovered by J. Mery to be visible in a living cat plunged under water, *Mém. de l'Acad. des Sc. de Paris, avant* 1699, t. x. p. 650.; and 1704, p. 265.

The most beautifully radiated surface of the retina in the hare was displayed by Zinn in an admirable engraving. *Comm. Soc. Scient. Gotting.* t. iv. 1754, tab. viii. fig. 3.

By Fontana, in the rabbit, *Sur le vénin de la vipère*, vol. ii. tab. v. fig. 12."

[h] "A plate accurately representing the course of these branches will be found in the *Œuvres de* Mariotte, p. 527. fig. 1."

[i] "Sömmerring, *De Foramine centrali limbo luteo cincto retinæ humanæ*: in the *Comment. Soc. Reg. Scient. Gotting.* t. xiii.

Ph. Michaelis, *Journal der Erfindungen in der Natur-und Arzneywiss*, P. xv."

[k] "As I have discovered this central aperture in the eye of no animal besides man, except the *quadrumana*, the axes of whose eyes are, like the human, parallel to each other, I think its *use* connected with this parallel direction of the eyes, and have endeavoured to explain the connection at large, in my *Handbuch der vergleichenden Anatomie*, p. 402. sq. 2d edit.

As, on the one hand, this direction of the eyes renders one object visible to both at the same time, and therefore more distinctly visible; so, on the other, this foramen prevents the inconvenience of too intense a light, if there is a probability that it expands and dilates a little under this circumstance, and thus removes the principal focus from the very sensible centre of the retina."

[1] *Phil. Trans.* 1819. Also, on various other points in the anatomy of the eye, *Med. Chirurg. Trans.* vol. xii. P. 2.

"The *iris* (whose posterior surface is lined by a brown pigment, and termed *uvea*) lies anteriorly to the ciliary processes, is flat, and washed on all sides by the aqueous humour; narrower towards the nose, broader towards the temples. Its texture is dense and cellular, and contains no vestige of muscular fibre. We must regard it, with Zinn[m], as a membrane sui generis, and not as a prolongation of the chorioid. The anterior surface is differently coloured in different persons, and, during life, has a flocculent appearance.[n]

"The blood-vessels of the iris run chiefly on its anterior surface, and in the fœtus are continued into the *membrana pupillaris*[o], which begins to open in its centre at the seventh or eighth month of pregnancy,—when the eyes have acquired some degree of size, and when, probably, the elliptic arches of its vessels begin to be gradually retracted into the *inner ring of the iris*, which ring I have never been able to perceive distinctly before that period.

"The posterior of the two circular membranes bears the name of *ligamentum* or *corpus ciliare;* and, inclining backwards, lies at a distance from the iris. Its external edge is thick[p] and adheres to the ciliary circle: the internal is thin, and, together with the adjacent *zonula* of Zinn[q], surrounds the margin of the capsule of the lens. The brown pigment is copiously diffused over it.

"Its anterior surface, lying opposite to the uvea, is striated.

"The posterior, lying upon the vitreous humour, is marked by about seventy plicæ, which are beautifully flocculent, and remarkable for a set of indescribably minute and elegant blood-

[m] "*Comment. Soc. Scient. Gotting.* t. iv. p. 199."

[n] "On the remarkable mutual relation of the arteries and nerves of the internal parts of the eye, and especially of the iris, see Diet. G. Kieser, *De Anamorphosi oculi.* Gotting. 1804. 4to."

[o] "This beautiful membrane was first discovered by Francis Sandys—a celebrated maker of anatomical preparations: it was first described and exhibited in an engraving by Ever. J. Wachendorf, *Commerc. litter. Nor.* 1740, hebd. 18."

[p] "The ciliary canal, discovered by Fel. Fontana, (*Sur le vénin de la vipère,* vol. ii. tab. vii. fig. 8, 9, 10.) and afterwards described more accurately by Adolp. Murray (*Nov. act. Upsaliens.* vol. iii.), runs, in bisulcous animals, along this thick edge."

[q] "Doellinger, *Nov. Act. Ac.* N. C. t. ix. p. 267. sqq. tab. vii.

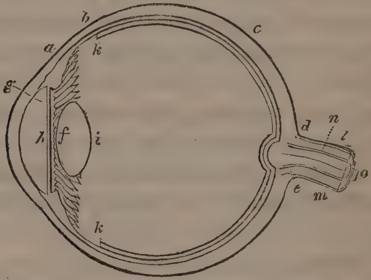
C. J. M. Langenbeck, *Neue Bibl. für die Chirurgie,* iii. B. 1. St. tab. 1. 11."

vessels. These flocculi are named *ciliary processes*, and their use is still an object of inquiry.[r]

"In the bulb of the eye, whose coats we have now described, are contained the *humours*, of three principal kinds.

"The posterior, and by far the greater, part of the globe is filled by the *vitreous* humour, which is in larger quantity proportionally in the human subject, especially after puberty, than in other animals, and so dispersed in innumerable drops throughout the cells of the delicate *hyaloid membrane* that this membranaceo-lymphatic body has the singular appearance of a tremulous jelly.

"Anteriorly it adheres to, and the *zonula* just mentioned surrounds, the capsule containing the *crystalline lens*, immediately around which lies the water of Morgagni."



a, point of junction of the sclerotic and cornea.
b, c, d, the sclerotic; growing thicker and thicker posteriorly.
e, opening of the sclerotic through which the optic nerve runs.
f, anterior surface of the crystalline lens, bounding the anterior chamber of the eye.
g, iris.
h, anterior chamber of the eye.
i, posterior surface of the crystalline.
k k, anterior termination of the retina.
l, m, fibrous covering of the optic nerve, continuous with the sclerotic.
n, proper covering of the optic nerve.
o, section of the optic nerve.

"The lens, itself also very pellucid, is cellular, but so much more dense than the vitreous humour that in the hand it seems

[r] "Consult, among others, Brandis, *Pathologie*, p. 253.
And J. Aug. Hegar, *De Oculi partibus quibusdam*. Gotting. 1818. 8vo. p. 25. sqq."

like a very tenacious, although an amazingly clear, glue. Its nucleus is more dense than the exterior laminæ. The laminæ may be reduced into extremely delicate fibres, converging from the circumference to the centre.[s]

" In an adult man the lens is proportionally to the whole body smaller than in quadruped mammalia; also less convex, especially on its anterior surface.

" The remaining space of the eye is filled by the *aqueous humour*, which is very limpid, and divided by the iris into two *chambers:* — the anterior and larger separating the cornea and iris; and the posterior, in which the uvea lies towards the corpus ciliare, so small as scarcely believed by some to exist.

" These most valuable parts are defended from injury both by the depth of their situation in the orbits and by the valvular coverings of the eye-lids.

" In the duplicature of the *palpebræ*, lie the *sebaceous follicles* of Meibomius[t], thickly distributed: and their edges are fringed by a triple or quadruple series of *cilia*[u]: the cartilaginous *tarsi* serve for their support and expansion, and also facilitate their motion upon the eye-ball.

" Above the eyelids, to use the language of Cicero, are placed the *supercilia*, which preserve the eyes from the sweat flowing from the head and forehead, and in some measure screen them from too strong a light.

" To lubricate the eyes, to preserve their brightness, and to wash away foreign matters, is the office of the *tears;* the chief source of which is a conglomerate gland placed in the upper and exterior part of the orbit. It has numerous but very fine excretory ducts, which are said to discharge about two ounces of tears upon each eye during the twenty-four hours: the tears are afterwards absorbed by the puncta lachrymalia, the function of which may, in a certain sense, be compared to that of the lacteals in the villous coat of the small intestines; from the puncta they are conveyed through the snail's horns, as they are called, into

[s] " Th. Young, *Phil. Trans.* 1795, tab. xx. fig. 2, 3.
Dav. Hosack, ib. 1794, tab. xvii. fig. 4.
J. C. Reil, *De lentis crystallinæ structura fibrosa.* Hal. 1743. 8vo."

[t] " H. Meibomius, *De vasis palpebrarum novis ep.* Helmst. 1666. 4to."

[u] " B. S. Albinus, *Annotat. Academ.* l. iii. tab. iii. fig. 4."

the lachrymal sac, and thence pass into the lower meatus of the nostrils."[x]

The tears appear to me to pass over the ball of the eye as low as the edge of the superior tarsus, which is so applied to the ball as not ordinarily to allow of their ready escape under it.[y] As the upper lid descends and nearly covers the front of the eye during sleep, for the lower has but little motion and the fine inner edges of both meet, the whole of the ball is at this time readily preserved moist. But, when the eyes are open, the front of the eye between the lids would not be moistened unless the upper tarsus occasionally descended with the fluid contained behind it. A portion of the fluid, thus brought down upon the front of the eye, remains after the upper lid rises again after winking, and trickles by its gravity as far as the inferior tarsus, which, ascending a little as often as the superior descends, raises it somewhat. Winking thus preserves the front of the eye constantly moist during the waking state. The under eyelid in rising moves towards the nose, as Sir C. Bell pointed out, and thus directs the tears towards the puncta, and extraneous matters are both pushed and washed towards the inner canthus, where the tears are always seen to run over first.

It may be also observed that, when the tarsi approximate, as they drive before them the moisture of the front of the eye-ball, and the lower at the same time moves it somewhat towards the nose, they quite inundate the puncta lachrymalia, by which circumstance the puncta are, of course, enabled to carry off a large quantity of the secretion, and ordinarily to prevent its overflow, which would occur at the centre of the lower tarsus. During sleep the puncta are not so copiously supplied, as they have only the same share of tears as the eye in general; and there is less occasion for it, because the removal of the stimulus of air and light by the closure of the eyelids lessens the secretion.

[x] "J. Chr. Rosenmüller, *Organor. lachrymalium partiumque externarum oculi humani Descriptio Anatomica.* Lips. 1797. 4to.

[y] The object of this firm application of the tarsi to the eye must be the exclusion of foreign matters from the orbit. Sir C. Bell says that the margins of the eyelids touch at their outer edges only, and leave a gutter between them and the cornea. I cannot conceive this, as the inner edge of the tarsi appears firmly applied to the eye. *Phil. Trans.* 1823.

Dr. Magendie has found the matter of the tarsal or Meibomian glands to be not sebaceous but albuminous, and soluble in the tears : hence we discover why, during sleep, it accumulates on the tarsi, — because its solvent, the tears, are not sufficiently abundant to remove it.

"Thus much it was necessary to premise upon the structure of the organ of vision. We now come to the function of the organ, — to the explanation of vision."

Sir D. Brewster, the best authority upon this subject, gives the following data respecting the dimensions, motions, and refractions of the eye. The total length of the axis of the eye is about 0·91 inch ; the principal focal distance of the crystalline lens is 1·73 ; and the range of the moving eyeball, which determines the field of *distinct* vision, is 110°. The eye being stationary, its field of vision is 120° in the vertical plane, 50° being above the horizontal line and 70° below it. In the horizontal plane its field is 150°, having 60° inwards and 90° outwards.

The refractive powers of the different humours of the eye are as follows ; the ray of light being incident upon them from air :—

Aqueous humour.	Crystalline Lens. Surface.	Crystalline Lens. Centre.	Crystalline Lens. Mean.	Vitreous humour.
1·336	1·3767	1·3990	1·3839	1·3394.

The refractive index of the aqueous humour, it will be observed, is almost precisely that of pure water ; and the indices of the other media do not greatly differ from it.

As the rays refracted by the aqueous humour pass into the crystalline, and those from the crystalline into the vitreous humour, the indices of refraction of each separating surface of these humours will be

From aqueous humour to outer coat of the crystalline - -	1·0466
From ditto to crystalline, the mean index being used - -	1·0353
From vitreous to crystalline outer coat - - - -	1·0445
From ditto to ditto, the mean index being used - -	1·0332

"Rays of light, falling upon the cornea at an angle more acute

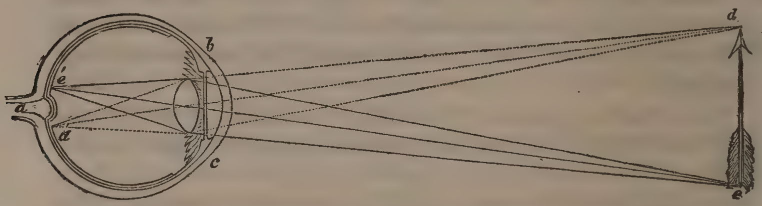
than forty-eight degrees, pass through it, and, from both its density and figure, are considerably refracted towards the axis of the eye, and on entering the aqueous humour they experience rather a less degree of refraction.

"Those rays which penetrate the pupil, and are received by the lens, are still more refracted on account of the greater density of this medium.

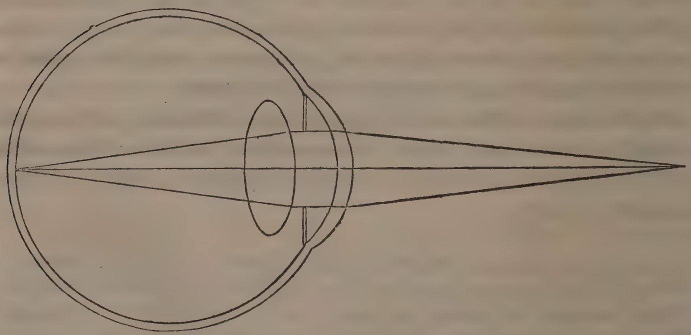
"The less density of the vitreous humour prevents the focus of rays from being too short, and allows it to fall upon the retina and exhibit the image of objects, though, from the laws of light, necessarily inverted."

By means of the indices of refraction above given, and the known dimensions of the eye, it is easy to determine the path which the rays of light travel through the humours of the eye, whether they fall upon it in a parallel or a diverging condition.

Let *a b c* be the eye, and *d e* an object at a considerable



This figure shows how the images of external objects are formed on the retina.



This figure shows how the rays of light issuing from a point fall divergingly on the cornea, and are afterwards refracted so as to meet again in a single point on the retina.

distance from it. The rays which diverge from d and e will, after undergoing the various refractions, converge to the points d' e' upon the retina, and will there form an inverted image of it, precisely in the same manner as a convex lens forms an image upon a sheet of white paper placed at its focus.

That an image or picture is actually thus formed on the retina, may be shown by scraping away the sclerotic coat of the eye of an ox, until it is sufficiently transparent for the image to be seen through it.

"Although the whole of the retina is sensible, it is not throughout equally calculated to receive the images of objects.

"In the first place, the true axis of the human [z] eye, where the optic nerve enters, is proved, by the well-known experiment of Mariotte [a], to be nearly insensible to light.

"The *principal focus* of the rest of the retina, and which must be considered as the chief instrument of distinct vision, falls upon an imaginary axis of the globe, corresponding with the centre of the cornea and of the whole eye. This, however, as Kaestner observes in opposition to Boerhaave, is not to be understood as if only one point of an object could be seen distinctly at once, the eye being fixed, and that, to behold another point, the axis of the eye must be changed; for the sensation of an entire object is simple and complete. [b]

"The habit of directing the axes of the eyes rapidly towards objects is acquired by practice. This is proved by the example of persons who were born blind but recovered their sight after puberty [c]; and of children, who seldom acquire this facility of motion before the third month.

"An object can never be seen unless the angle of vision exceeds 34 *seconds*. This was proved by the very beautiful experiments of the acute Tob. Mayer, who formerly was one of our number: and he demonstrated the great perfection of the human

[z] "I say the human eye; for in some animals now before me, the seal and porcupine, for instance, the true and imaginary axes are the same, the optic nerve lying exactly opposite the centre of the cornea and pupil."

[a] "Troxler speaks of this at large, l. c. t. ii. P. ii. p. 1."

[b] "*In Optica Quædam* Boerhaavii et Halleri *Commentatur* Abr. Gotth. Kaestner. Lips. 1785. 8vo. p. 7."

[c] "See Giov. Bortolazzi, *Sopra una cieca nata guarita.* Verona, 1781. 8vo. p. 99. sq."

sight, by showing that this still remained the limit of vision in any light, — in the splendour of the meridian sun and the faint light of a lantern; so that vision remains almost equally distinct, although the light be considerably diminished.[d]

"We may hence infer the extreme minuteness of the images of objects projected upon the retina[e], and nevertheless impressed so forcibly upon it, that, under certain circumstances, their vestiges remain after the removal of the objects from before the eye.[f]

It has frequently been a question among philosophers, why objects are seen erect, when the images which suggest them to the mind are thus inverted. Some have supposed that infants at first see objects upside down, and afterwards learn to correct their erroneous sensation by comparing the information acquired by touch with that obtained by sight. This opinion, held by Locke, Lecat, Diderot, Buffon, &c., as well as that of our originally seeing objects double and all as at the same distance and correcting these errors by experience and the sense of touch, was amply refuted by Bishop Berkley, and subsequently by Gall[g] and others. The law of visible direction affords the true explanation. The simple statement of this law is that each point of an object is seen in a line perpendicular to the point of the retina on which its image falls. The surface of the retina being concave and nearly as possible spherical, these lines of visible direction meet and cross at a point within the eye which is called the centre of visible direction: the lines from the upper part of the image go to the lower part of the object, and those from the lower part of the image proceed to the upper part of the object. An inverted image thus necessarily produces an erect object, and the external object is the

[d] "Tob. Mayer, *Experimenta circa visus aciem*, in the *Commentar. Soc. Scient. Gotting.* t. iv."

[e] "De la Hire, *Accidens de la Vue*, p. 375."

[f] "Gassendi, *Vita* Peireskii, p. 175. sq. Hague, 1655. 4to.

Franklin, *Letters on Philosophical Subjects*, at the end of his *Expts. on Electricity*. Lond. 1769. 4to. p. 469. sq.

Rob. War. Darwin, *Experimenta nova de spectris s. imaginibus ocularibus, quæ objectis lucidioribus antea visis, in oculo clauso vel averso percipiuntur*. Lugd. Bat. 1785. 4to.

Dr. Darwin, *Zoonomia*, t. i.

C. Himly, *Biblioth. Ophthalmolog.* t. i. P. ii. p. 1."

[g] l. c. 4to. p. 180. sqq.

thing to which the mind attends, and not the picture on the retina. The mind is not placed behind the eye to look at this image, as an observer is placed behind a camera obscura: neither does it in this case, more than in any other concerning perception, attend to the sensations themselves, which serve solely to suggest to it the causes which produce them.

" Since many conditions are requisite for distinct vision, the Creator has wonderfully ordered the functions of these organs.

" A sufficient, but, at the same time, a definite, quantity of light, not too intense for distinct vision, is provided in two modes:—First, according to the greater or less intensity of the rays, a greater or less number of them pass to the lens;—Secondly, that portion which is superabundant and injurious to vision is absorbed.

" The first point is effected by the motion of the iris; the second, by the pigmentum nigrum.

" The iris is endowed with remarkable mobility, and thus accommodates itself to the intensity and distance of light, so that, when exposed to a strong light or to near objects, it may expand itself and contract the pupil, but, when to a weaker light or more remote objects, it may contract itself and dilate that opening.[h]

" Physiologists have given different explanations of this motion. Some ascribe it to the varied impulses of blood into the vessels; others to contraction of the imaginary muscular fibres of the iris. I have shown, in a particular treatise, that both these circumstances are impossible, and that its proximate cause may be sought for with more probability and reason in the vita propria of the iris; the more remote cause, as we formerly hinted, can be solely the reaction of the sensorium.[i]

" The function of the dark pigment, so frequently mentioned, viz. to absorb the superfluous rays, and, consequently, its importance to the perfection of vision, are demonstrated, among other modes, by the dissection of different kinds of animals, and by the diseased condition of Albinos, whose eyes are very

[h] " Zinn, *De Motu Uveæ*, 1757, in the *Comment. Soc. Scient. Gotting.* t. i. Fel. Fontana, *Dei Moti dell' Iride.* Lucca. 1765. 8vo."

[i] " For other explanations consult Troxler in Himly's *Ophthalmol. Biblioth.* t. i. P. ii. p. 21."

tender and impatient of light from the absence of this pigment."[k]

Adaptation of the eye.— When the eye is directed to objects at a distance, it is unable, at the same time, to see distinctly objects which are near. Some change is therefore requisite to accommodate the eye to see perfectly at different distances. That the eye thus adapts itself to distinct vision by a voluntary act, is evident from the following simple experiment. If you hold a pencil near the eye and direct the attention steadfastly to it, distant objects will appear confused; but if, without changing the position of the eye, the attention be transferred to these distant objects, they will become distinct and the pencil will appear confused. Many hypotheses have been proposed to explain the actions by which this adaptation of the eye is effected, but none yet advanced has been deemed entirely satisfactory. Kepler supposed that the eye elongates itself in the direction of its axis in proportion as the object to be viewed is nearer. Dr. Jurin, Sir E. Home, Ramsden, and others, regarded the cornea as capable of changing its form and curvature,— becoming more convex when the eye is adjusted to see nearer objects. Descartes, Pemberton, Albinus, Hunter, Olbers, and Dr. Young have endeavoured to prove that the crystalline lens is capable of moving in the direction of the axis of the eye so as to vary its distance from the retina, — that it advances to see near objects, and recedes to become fit for seeing distant objects. La Hire and Le Roy supposed that the mobility of the pupil is alone sufficient to account for the phenomena. Dr. Magendie hastily denies that any adaptation is necessary, "because," says he, "the picture seen at the back of the eye of an ox, when the sclerotic is scraped away, is equally distinct at whatever distance the object is placed before it."

On paying attention to the phenomena, it will be observed that the effort of adapting the eye to a near object is invariably attended by the contraction of the pupil. Several eminent writers have hence considered the motion which causes the adaptation to be a consequence of the mobility of the iris. Dr. Knox thinks that the contraction of the iris alters the curvature of the crystalline lens; Sir D. Brewster, that it displaces the crystalline;

[k] "I have spoken of Albinos at large in my work, *De Generis Humani Varietate Nativa,* ed. 3. p. 274.; and in my dissertation, *De Oculis Leucæthiopum.*"

and Prof. Mile of Warsaw, that it changes the curvature of the cornea.

Prof. Mile, by a great number of accurate and satisfactory experiments, for which I refer the reader to the original memoir [1], has arrived at the following conclusions. Their truth is independent of his hypothesis of the dependence of the curvature of the cornea on the contraction of the iris, and the opinion of Sir D. Brewster or Dr. Knox might be substituted for it with equal propriety.

The eye does not see with equal distinctness objects at all distances, but only when they are within a certain distance. This does not depend on external causes, such as the diminution of the optic angle, and the obscuration of the object by the intermediate air; for, to see clearly and to see distinctly are not identical. The causes of distinct vision are internal, and situated in the eye itself. They are two in number: one disposes the eye for the continuous distinct vision, and the other for the transient distinct vision of objects at different distances; but neither of them can act except within certain limits. These limits are greater for the presbyope, or shortsighted, than for the myope, or long-sighted, person. These adaptations both depend on the action of the iris, which can at the same time act in two ways to produce two effects: first, by the contraction of its aperture, and, secondly, by the flexion of the cornea; the alteration of the size of the pupil only, however, is visible. The adaptation of the eye for the continuous distinct vision of objects contained within certain limits is owing to the diffraction of the rays of light near the edge of the aperture of the iris, in consequence of which there are formed, by a single external luminous point, several foci instead of one successively ranged in a line of a certain length; so that the object may change its distance within certain limits, and yet one of its foci shall always fall on the bottom of the eye. This focal length is inversely as the magnitude of the pupil. The borders of indistinct objects appear radiated, and to the phenomenon of confusion is added the motion and multiplication of the

[1] *De la cause qui dispose l'œil pour voir distinctement les objéts placés à différentes distances:* par Jean Mile (traduit du Polonais). Magendie, *Journal de Physiologie*, t. vi. p. 166.

image when the edges of bodies are brought near the side of the fasciculus of rays which enter the eye: prismatic colours also appear. All these phenomena, which are observed in an eye performing its functions, may be produced by an apparatus, the structure of which resembles that of the eye; and even by a common lens, if we substitute for the motion of the pupil diaphragms of different sizes. The nature of all these phenomena proves that diffraction is their common origin, and they may be considered as constituting a separate kind of optical illusions resulting from diffraction. The second cause which adapts the eye for the momentaneous distinct vision of objects depends neither on the action of the external muscles of the eye, the advancement of the bottom of the eye, nor on any alteration of the form or position of the crystalline lens; but appears to be owing rather to the change of the curvature of the cornea by the contraction of the iris, which occurs only when the eye adapts itself to see very near objects, as is proved by the simultaneous approximation of the pupil.

Besides the motions of the pupil which accompany the adaptation of the eye to different distances, it also varies with the intensity of the light to which the eye is exposed, contracting in a strong light, and dilating in a faint light. This effect is particularly observable in persons whose pupils are large. The sympathetic action of the pupils of both eyes is worthy of remark: while the same light is regarded, the pupil of one eye will dilate immediately the other eye is covered, and again contract when the hand is removed and both organs are equally exposed to the light.

Correction of spherical aberration in the eye. — In ordinary lenses the rays which pass through them at different distances from the centre are not refracted to the same point or focus, and the images they form are consequently indistinct. This defect, which is called spherical aberration, is, according to Sir D. Brewster, remedied in the eye by means of the variable density of the crystalline lens. The refractive power of this body being greatest at its centre, and decreasing towards its circumference, the central and extreme rays are both refracted to the same point. According to the experiments of M. Chossat, the ellipsoidal figure of the cornea is sufficient to effect this correction.

Chromatic aberration. — In consequence of each differently

coloured ray possessing a different index of refraction in the same medium, a lens refracts these variously coloured rays to different points or foci. This effect, which is called chromatic aberration, is another cause of indistinctness in images formed by lenses, for from this cause they appear surrounded with coloured fringes. When the eye, however, is adjusted to the proper focal distance, an object appears perfectly colourless. It is evident, therefore, that either the eye, when thus adjusted, is by some contrivance rendered achromatic, or that the aberration is so small as to be insensible. Sir D. Brewster is of the latter opinion, which was also held by Dr. Maskelyne. Of those who maintain that there exists a correction for chromatic aberration, Euler, Coddington, and Professor Powell assert that a compensation takes place between the refractions of the different media of the eye, each giving a different explanation; while D'Alembert supposes that the agitation, occasioned at any one point of the retina, extends itself into the adjacent points, and, each point being thus influenced by the sum of the effects due to all the coloured rays at once, perfect vision is the result. When the rays do not converge accurately on the retina, the dispersion is sensible; and, from this cause, objects, seen either within or beyond the proper focal distance, are seen with coloured borders.

Single vision with two eyes. — When we look at an object, an image is formed on the retina of each eye, and yet we see only a single object. Two different opinions have been maintained respecting the cause of this singleness of vision with both eyes. Several distinguished philosophers, and among others Dr. Reid, suppose that there is a physiological connection between certain points of the two retinæ, and that objects are only perceived as single when their images fall on corresponding parts of the retinæ: the decussation of the optic nerve is brought as an argument in support of this opinion. Others, including Dr. Smith and Sir D. Brewster, do not admit this supposed necessary connection between corresponding points of the expansion of the optic nerve, but assert that objects are seen single merely because they are seen by both eyes in the same place; single vision is, according to this opinion, a necessary consequence of the law of visible direction.

Insensible spot of the retina. — The retina, from its being an expansion of the optic nerve, has generally been regarded as the

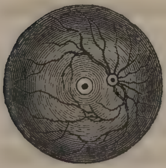
seat of vision. But Mariotte, having found that images which fall on that part of the retina where the optic nerve enters it are invisible, concluded, because where there is no chorioid there is no vision, that the chorioid performs the functions attributed by most physiologists to the retina.

Mariotte performed his well-known experiment in the following manner: — He made two spots in the same horizontal line upon the wall of a room, and, having closed the left eye, placed the right eye opposite the left spot, and gradually moved backwards until the right hand spot disappeared, — a circumstance which occurs when the image falls on the place where the optic nerve enters the retina. The experiment succeeds very well when two wafers are placed on the wall about three inches apart, and the observer commences to recede when at the distance of twelve inches from them. A very ready mode of trying this experiment is the following: — Place two coloured wafers upon a sheet of white paper, close one eye and fix the other opposite one of the wafers, then move the outside wafer, always in the same straight line, until it is invisible; when in this situation, if the wafer be moved to the right, to the left, above, or beneath, it is again seen.

Purkinje has remarked that the spot of the retina is not insensible to the stimulus of light, as it is generally stated to be; for, if a candle be substituted for the moving wafer of the preceding experiment, though the flame is not seen, a red glare is perceived. It can scarcely be doubted that the insensible point is the place occupied by the central artery of the retina, and the chief argument for the chorioid being the seat of vision therefore falls to the ground.

We are indebted to Purkinje for a most beautiful experiment, by which a person may see the blood-vessels of his own retina. The experiment succeeds best in a dark room, when one eye is shaded from the light, and the flame of a candle is placed by the side of the unshaded eye, but so as not to occupy any of the central part of the field of view. So long as the flame of the candle remains stationary, nothing further occurs than a diminution of the sensibility of the retina to light: but, after the flame has been moved upwards and downwards, through a small space, for a length of time, varying with the susceptibility of the person on whom the experiment is tried, the phenomenon presents itself. The blood-vessels of the retina, exactly as represented in the

engravings of Sömmerring, are distinctly seen greatly magnified and projected apparently on a plane before the eye. The image continues only so long as the flame is in motion: when the flame becomes stationary, it immediately dissolves into fragments and soon after disappears. Prof. Wheatstone finds that the susceptibility of seeing it depends upon the size of the pupil: the image readily appears to those whose pupils are large, while, on the contrary, the experiment rarely succeeds with a person whose pupil is small. I can see the blood-vessels of my own retina and the blood circulating through them, just as in a frog's web under the microscope, by merely closing my eyes and excluding the light by placing my hand before them. The phenomenon occurs in this way more readily at one time than at another: and some persons say they never perceive it.



A view of the retina, with the ramification of its central artery. In the centre is seen its central hole, surrounded by a circle. To one side of this is the bulb of the optic nerve.

Purkinje has attempted no explanation of this phenomenon, but contented himself with simply stating the fact. Prof. Wheatstone considers that it is a shadow, resulting from the obstruction of light by the blood-vessels spread over the retina. The difficulty, he observes, is not to account for the appearance of the image, but to explain why this shadow is not always visible. He adduces a number of facts observed by Pictet, Sir D. Brewster, and others, which tend to prove that an object, either more or less luminous than the ground on which it is placed, becomes invisible when continuously presented to the same point of the retina, the rapidity of its disappearance being greater as the difference of luminous intensity between the object and the ground is less: but, by continually shifting the place of the object on the retina, or by making it act intermittingly on the same point, the object may be rendered permanently visible. To apply this explanation to Purkinje's experiment, Prof. Wheatstone observes that, whenever the flame of the candle changes its place, the shadows of the vessels fall on different parts of the retina; as is evident from

the motion of the figure, which, while the eye remains at rest, is always in a contrary direction to that of the flame. Hence the shadow, being thus made to change its place on the retina, remains, according to the law above stated, permanently visible; but, instantly the flame is at rest, the shadow also becomes stationary and consequently disappears.

Sir D. Brewster offers a different explanation. He considers that the light is propagated from the luminous image of the candle to other parts of the retina, and that, though the retina, in contact with the blood-vessels, is sensible to direct light, it is insensible to propagated light, and therefore the blood-vessels are delineated in obscure lines. This explanation does not agree with the fact that the vessels continue to be seen only while the flame is in motion.

Prof. Wheatstone has described several original and instructive variations of the experiment, for which we must refer to his own account.[m]

Duration of luminous impressions on the retina. — The effect of light upon the eye continues for some time after the light itself has ceased to act. If a red-hot coal be rapidly whirled round so as to return to the precise point from which it started, it will produce a perfect ring of light, although the coal can be at one point only of the circle at the same instant. Chevalier D'Arcy was the first who made this experiment the subject of philosophical consideration: he ascertained that the impression on the retina remained about the eighth of a second. Prof. Wheatstone has devised a very instructive experiment to illustrate this property of vision. A narrow slit is made in a disc from the centre to the circumference: when this disc is stationary and held before a window blind or a strongly illuminated picture, a very limited portion only of the object is seen through the linear aperture; but, on causing it to revolve rapidly on its centre, the different portions of the picture, which are seen through the disc in its successive positions, remaining on the eye, the entire object is visible at the same time and the solid disc appears perfectly transparent.

The stationary appearances of moving wheels as observed by Drs. Roget and Faraday, Dr. Paris's thaumatrope, Professor

[m] *Contributions to the Physiology of Vision. Journal of the Royal Institution*, Nos. 1. and 3.

Plateau's well known optical illusion — the phantascope, Prof. Wheatstone's kaleidophone, and the revolving mirror by which he has measured the velocity of electricity and the duration of the electric spark, are all applications of this physiological law.

Ocular spectra. —When the eye has been fatigued by looking at any particular kind of coloured light, and is afterwards directed to a white surface, the surface will not appear white, but of a different colour, which is called the accidental colour of the colour which was first regarded by the eye. This fact may be proved by placing a *red* wafer on a sheet of white paper, and fixing the eye for some time steadily to a dot at its centre: when the eye is turned aside to an uncovered part of the paper, a circular spot of the same size as the wafer will be seen, but its colour will be *green*. This image changes its position as the eye moves, and is called an ocular spectrum.

To determine the accidental colour of any colour originally presented to the eye, the following remarks must be attended to. There are three primary and distinct colours, red, yellow, and blue; and all the compound colours that exist in nature are different combinations of these. Orange is a compound of red and yellow; green, of yellow and blue; purple, of blue and red; and white is a neutral combination of the three primary colours. An accidental colour is always found to be that which, added to the original colour, produces white; and these two colours are hence said to be complementary.

The theories which have been advanced to account for the phenomena of ocular spectra may be reduced to two.

The most usual theory in its most general form supposes that, when any simple or compound colour is continuously presented to the eye, the part of the retina where the image falls becomes less sensible to impressions of the same kind, but retains its susceptibility for other kinds of impressions: if, therefore, while the retina is in this state, the eye is transferred to a white surface, the spectrum will appear as if the colour originally seen were subtracted from the white. This explanation agrees with a great many observed facts, but there is one which seems in direct contradiction to it. A complementary spectrum is seen when the eye is shut, and when, consequently, there is no white light to furnish the complementary colour. This phenomenon has given rise to another explanation as to the origin of ocular spectra,

which assumes that any colour presented to the retina stimulates it and excites it to a reverse action which produces the complementary colour. Professor Plateau has supported this theory with much ingenuity, but there are numerous facts which do not accord with it.

Longsightedness and shortsightedness. — That case of defective vision which is called longsightedness arises from the crystalline lens being too flat; the rays proceeding from near objects, instead of converging to distinct foci on the retina, converge behind it, and therefore form no distinct image. This defect, which is an ordinary effect of old age, may be remedied by the use of a convex lens, which enables the eye to converge the rays so as to form a perfect image on the retina.[n]

Shortsighted persons are unable to see at a distance, and are obliged to bring small objects very near the eye to see them distinctly. This defect, which often occurs in young persons, arises from the eye being too convex, from which cause the rays of distant objects converge to foci before they fall on the retina. The imperfection may be remedied by using a concave lens, which renders the rays less converging and enables them to form a distinct picture at the bottom of the eye. There are other cases of defective vision arising from the malformation of the organ, but these are of the most common occurrence.

[n] In hemiplegia, a sense sometimes becomes morbidly acute. Dr. Heberden (*Comment.* p. 292.) mentions a hemiplegic person whose smell became greatly heightened. Frequently we find such patients sensible to the crawling of the minutest insect on the arm. I lately attended a gentleman about forty years of age, who had suddenly been attacked with hemiplegia, and in bed he heard the least sound at the bottom of the house with an acuteness which surprised him, and could tell the hour by a watch placed on a table at such a distance from his bed as to have rendered it impossible for him to distinguish the hands when he was in health. Dr. Brachet relates that, when he was *interne* at the Bicêtre in 1811, the *infirmier* of the surgical ward one day astonished him by the extent which his vision had acquired since the day before. The man could distinguish the most minute objects at an enormous distance. Five hours afterwards he felt a slight headach, and in a few hours more was seized with a thundering apoplexy (*une apoplexie foudroyante*), and died the next night. A fresh coagulum was found in the right optic thalamus. The inflammation which had preceded this effusion had irritated by its proximity a part of the brain concerned in vision. These were instances of longsightedness; but not of mere longsightedness, but general acuteness of sight, as the persons saw well not only at great distances, but at small distances likewise.

Optic nerves. — Such facts have been thought a reason for believing the decussation of the optic nerves partial, and some say that the outer portion of the tractus optici goes to the outer part of the corresponding nerves, and the inner to the inner portion of the opposite. But Dr. Magendie divided from before backwards the junction of the optic nerves, and found blindness induced.[o]

The decussation of the optic nerves is shown by blindness of one eye being induced if the nerve on the same side is divided anteriorly to the union, and of the opposite eye if the division is made posteriorly to the union: or by destruction of an eye causing the nerve of the same side to waste as far as the union, and of the opposite side beyond the union.[p] Yet cases are on record where the wasting of the nerve in loss of sight continued throughout on the same side, but such are probably suspicious.

The thalami optici are improperly named, as they do not give origin to the optic nerves. These may be traced to the anterior corpora quadrigemina, pressure or disease of which produces blindness, and which waste if the nerves waste.[q] Sömmerring first noticed this in blind horses. Gall confirmed his observations. Dr. Vimont states that, on examining fourteen old blind horses, he found the anterior quadrigeminum opposite the blind eye lessened in all, and completely atrophied in two. He then cruelly took out the left eye of four rabbits, the right of four others, and both eyes of another. At the expiration of ten months he killed them all, and found the right anterior quadrigeminum much smaller than the left in the first four, the reverse in the second four; and both the anterior and posterior much smaller in the rabbit deprived of both eyes than the healthy tubercles of the other eight. The optic nerve of all the blind eyes had lost $\frac{1}{3}$ of its volume, and looked like the horn of a lantern. Dr. Magendie informed Dr. Vimont that the atrophy of the tubercle occurs much more quickly in birds, and Dr. Vimont found this to be the fact.[r]

Drs. Carus and Tiedemann make Gall consider the posterior quadrigemina as the roots of the olfactory pair, whereas he has

[o] *Précis de Physiologie*, t. i. p. 71.

[p] Dr. Magendie, l. c. ibid.

[q] On the optic nerve consult Gall, l. c. 4to. t. i. p. 113. sqq.

[r] l. c. t. i. p. 296. sq.

declared the opposite opinion on account of the existence of the posterior quadrigemina in animals apparently destitute of olfactory nerves. He believed that the posterior reinforced and protected the optic nerve as well as the anterior, but in a different manner, since in different animals they are in different proportions, and the posterior scarcely perceptible, if not absent, in some whose vision is perfect. Nay, he believed that the greater part of the corpora quadrigemina have other offices relating to the spinal chord below and to other cerebral parts than those concerned in vision above. If the surface either of their anterior part, of the bulb of the olfactory nerve, of the grey band on the sides of the fourth ventricle, or of the ganglion of the acoustic nerve, is touched, no contraction ensues; but injure them to a certain depth, and convulsions take place.[s] The optic nerve is certainly not derived, he says, from the tubercles only; the internal and external corpora geniculata, &c. give it many filaments.

Many recorded cases, as well as many in my own practice, prove that one half of the retina may be paralysed, while the other half remains unaffected; and this effect may be common to both eyes, or peculiar to one. Dr. Wollaston[t] relates that it twice occurred to him not to be able to see but on one side of the axis of vision. The first time, the left side of each eye was affected; he saw but the half of a man's face or of any object he looked at; and, in attempting to read the name JOHNSON over a door, he saw only .... SON, the commencement of the name being totally obliterated from his view: the complaint was of short duration. About nineteen years afterwards the phenomenon recurred: this time, the right side of the eye, about three degrees from the centre of the retina, was affected, and its duration was ten minutes. Two analogous cases are also mentioned by Dr. Wollaston. Desmoulins[u] states that M. Arago has experienced this affection of vision three times: the first two times, objects situated to the right of the axis of vision were invisible; the third time he saw objects on the right only of this axis. The same author notices also the following remarkable case. In consequence of a cerebral fever, the external side of the left retina of M. de M—— became insensible: with this eye he

[s] l.c. 8vo. vi. p. 253.

[t] *Phil. Trans.* 1824.

[u] *Anatomie des systèmes nerveux des animaux à vertèbres,* t. ii. p. 673.

saw objects only situate to the left of the centre of vision, and, as at the same time there was an outward deviation of the axis of this eye, through a paralysis of the nerve of the third pair, when he employed both eyes, he saw objects double; but, what was still more singular, the right eye being closed, he saw with the left eye the objects removed from twenty to twenty-five degrees to the right of their real position.

If the fifth pair, which gives sensibility to the face, is divided, the eye, nose, and tongue, lose their sense of touch, — ordinary sensibility,—in common with the skin, and are not excited by mechanical or acrid stimulus as before.[x] In this experiment, the pupil becomes greatly contracted in rabbits and guinea-pigs, and dilated in cats and dogs.[y] The retina has very little ordinary sensibility, as Dr. Magendie showed by pricking and tearing it with little or no pain; whence contraction of the pupil does not follow the application of any stimulus excepting light. The third pair, which is a nerve of motion, supplies, in common with the fifth pair, the iris, and therefore Mr. Mayo found that division of it, at least in cats and pigeons, causes dilatation of the pupil, like division of the optic nerve; the dilatation arising in the former case from the cerebral influence being no longer conveyed, and in the latter from the cerebral influence being no longer excited. On stimulating the ocular end of the third pair, divided in pigeons, after removing the brain, he says that the iris suddenly acts: and, on stimulating not the ocular, but the cerebral, end of a divided optic nerve, the same thing happens. M. Fleurens says that irritation of the superior quadrigemina causes contraction of the iris, and extirpation of them its dilatation.

Judgment of colour.—Persons, all having excellent eyes, and seeing perfectly well, differ much in their powers of recognising persons, finding their way, &c. In none of these points is the difference so striking as with respect to judging of colours. It is by no means uncommon to meet with individuals whose eyes appear excellent, and whose sight is excellent, and who may judge of form and distance correctly, but who cannot distinguish certain colours. Dr. Nicholl describes a boy who confounded green with red, and called

[x] Dr. Magendie, l. c.

[y] Dr. Magendie, l. c. Mr. Mayo informs us that, after death, in the cat and pigeon the pupil is always dilated, and in the rabbit contracted. *Outlines, &c.*

light red and pink, blue. His maternal grandfather, and one uncle, had the same imperfection. This uncle was in the navy, and, having a blue uniform coat and waistcoat, purchased a pair of red breeches *to match*.[z] Dr. Nicholl mentions a gentleman who could not distinguish green from red. The grass in full verdure always appeared to him what others call red; and ripe fruit on trees he could not distinguish from the leaves; a cucumber and a boiled lobster were of the same colour in his sight; and a leek resembled a stick of sealing-wax. This person had a brother and a niece — the daughter of another brother, in a similar predicament.[a] Indeed, the defect has frequently occurred in several members of the same family, and frequently has been hereditary, sometimes passing over a generation, like other peculiarities of structure. It is observed more frequently, perhaps, in men. In the rarest and most extreme cases no colour is distinguished, all objects appearing in this respect alike. In all the cases in which the point has been examined, the part of the cranium under which,

[z] *Med. Chir. Trans.* vol. vii.

[a] l. c. vol. ix. A case communicated to Dr. Priestley will be found in the *Phil. Trans.* 1777. The man had two brothers with the same defect. Another will be found in the vol. of 1778. The gentleman's father, maternal uncle, one of his sisters, and two of her sons, had the same defect. In the *Phrenol. Trans.* is another by Dr. Butter. In the *Manchester Memoirs*, vol. v., are others. One such person painted a man's head with a *green* beard and *blue* cheeks. In Mr. G. Combe's *System of Phrenology*, and the *Edinburgh Phrenological Transactions*, are mentioned one of three brothers and a cousin, who inherited it from their maternal grandfather, the intervening generation not having it. Professor Dugald Stewart, and Mr. Troughton, as well as many of his family, could not distinguish colours; and the celebrated instrument-maker was therefore prevented from applying himself to execute any thing in which it was necessary to distinguish them. Dr. Dalton has the same defect. A case of this defect is recorded in the *Edin. Phren. Trans.* by Dr. Butter of Plymouth; and, to show what irrational hostility is offered to phrenology by men of whom we might expect better things, I must mention that the paper was sent to the *Edinburgh Philosophical Journal*, but that the editor, Sir David Brewster, choosing that it should not support phrenology, altered the title, without consulting the author, to *Remarks on the Insensibility of the Eye to certain Colours*, and suppressed the phrenological comments, "for obvious reasons," he says, viz. that phrenology is not a 'substantial science." Yet Sir David Brewster would wish to be considered a philosopher in all his intellectual and moral doings. Still more lamentable and very recent conduct with the view of suppressing phrenological truth may be seen, in the case of *The Edin. Med. and Surgical Journal.* See *The Edinburgh Phrenological Journal*, December, 1836; and June, 1837, p. 632.

according to Gall, the organ for judging of the harmony of colours is placed, is flat or depressed. I have seen several of these cases, and in all this was the fact. In painters, remarkable for their excellence of colouring, this part is full or prominent. The contrast between this part of the forehead in a person who has the defect, and in another excelling in the power of colouring, placed side by side, is very striking.

Professor Dugald Stewart remarks that, "in the power of conceiving colours there are striking differences among individuals;" and he does not ascribe the difference to the eyes. "I am inclined to suspect," he says, "that in the greater number of instances the supposed defects of sight ought to be rather ascribed to a defect in the power of conception."[b] Mr. Stewart is correct in exempting the eye from blame, and ascribing the defect to a defect in conception; but, since he has no idea of a distinct faculty for colours, he means conception in general. Yet, as the individuals are not deficient in other conceptions, some reason must be given for the deficiency of conception in this one point. He thinks it arises "probably in consequence of some early habit of inattention." Now this is sad trifling in a philosopher. What particular attention do children, who distinguish colours accurately, bestow? They distinguish without effort; and those who cannot, are not only not proved to have been inattentive, but have, most probably, been often extraordinarily attentive, in the hope of seeing what others can see. How should want of attention to this one point run in families and be hereditary, passing through a generation, &c.? This is a specimen of the errors of metaphysicians. They see, and generally acknowledge, that the brain is the organ of the mind; yet they observe the faculties of the mind without even once considering the organ which possesses, or is employed in the working of, these faculties. Gall examined the two together, and we now know through him that local deficiency of brain both exists where the power of distinguishing colours is deficient, and is hereditary with this deficiency.

Motion of the eyes. — The eye is moved by six voluntary muscles, — four straight, a superior, inferior, external, and internal; and two oblique, a superior, with its tendon running round a pulley, and an inferior.

[b] *Elements of the Philosophy of the Human Mind*, ch. iii.

Left eye, seen outside, the outer part of the orbit having been removed.

1, 1. Portion of the upper part of the orbit belonging to the frontal bone.
2. Section passing through the malar bone and the malar process of the superior maxillary.
3. Globe.
4. External rectus muscle.
5. One of its two posterior insertions, running to the small wing of the sphenoid.
6. The other of these insertions, running inwards to the cavernous grove.
7. Inferior rectus.
8. Its posterior insertion.
9. Superior rectus.
10. Its posterior insertion in the small wing of the sphenoid.
11. Superior oblique.
12. Its reflected tendon.
13. Inferior oblique.
14. Internal rectus.
15. Levator palpebræ superioris.
16. Its posterior insertion.
17. Optic nerve.
18. Part of the sphenoid.

The motions of the eyes which result from the actions of these muscles were investigated, and the mental perceptions attending them analysed, with considerable success, by Dr. Wells. Sir Charles Bell long afterwards took up the subject, and published some opinions which appear to me altogether groundless.[c] He fancies that the pair of pathetic or internal motor nerves belong to

[c] *Phil. Trans.* 1823.

his respiratory set and are for expression, and that the two oblique muscles have the same destination, and are not voluntary; while the four recti muscles and their common motor and abducent pairs of nerves are voluntary. Now, in the first place, all the objections that I formerly made to his views of a respiratory set of nerves for expression (p. 459. sqq. *suprà*) hold good in the present case, which is merely a particular instance of those views. The absurdity of applying the term respiratory to nerves and muscles of the eye is too manifest to require comment. In the next place, he conceives that the two oblique muscles are never voluntary; and he contends that the superior draws the pupil downwards and outwards, the inferior upwards and inwards. Other writers[d] say downwards and inwards, and upwards and outwards; but he agrees with all, that their combined action draws the eye towards the nose, though I hardly understand how, on either supposition, such a motion inwards can result. Now, we can move the eyes downwards and outwards, and upwards and inwards, at pleasure: we can also make them approach each other at pleasure, and it is a mere assumption, and a very improbable assumption, that we do this by the internal straight muscles, and not by the combined action of the two obliques. He mentions experiments in which he divided the superior oblique, and another in which he divided the inferior oblique; and he asserts that the voluntary motions were unaffected. The poor animal no doubt moved its eye upwards and downwards, inwards and outwards, as it had four muscles left for these purposes: but we, of course, have no information given us that an attempt was made to induce the animal to approximate both eyes together, as in looking now at a *distant* and now at a *near* object in the same line; and this I believe to be the use of the oblique muscles, just as it is of the straight to act when we look in different *directions*. He divided the superior oblique of the right eye, held open the eyes, waved the hand before them, and found the right eye move upwards and inwards, and the other scarcely so in that direction, and the dog "seemed to have a difficulty in bringing it down again." But this did not show that the muscle was involuntary. If the superior oblique moves the eye downwards and outwards, its division explained, on his own views of the effects of these mnscles, why the animal could not move the eye

[d] *Manuel d'Anatomie comparée*, par Jules Cloquet, p. 139. sq.

simply inwards; and why the inferior pulled it inwards and upwards, being no longer antagonised by the upper; just as the muscles of one half the face draw the features to their side if their antagonists of the other half are paralysed. Not one experiment mentioned by him shows the oblique muscles to be involuntary. He says that when we wink, we draw the eyes up under the upper lid. Now we can wink voluntarily: and, if the eyes do ascend in winking, which I do not believe [e], why should they not ascend by the superior straight muscles? His ideas on the action of the oblique muscles seem all confusion. At one time he says that the superior oblique moves the pupil downwards and outwards, the inferior upwards and inwards, and that "their combined action draws the eye-ball *towards the nose*" (p. 312.): [f] at another (p. 327. sq.), that the eye rolls *upwards and inwards*, when they are balanced: at another (p. 314.), that, if the superior is prevented from acting by being divided, the eye equally turns upwards and inwards; and, indeed, (p. 315.) that the inferior gains in power of elevating the eye-ball by the division of its opponent the superior, and that is its own proper action. In many places (pp. 294. sq. 298. 303. 316. 326.) he speaks simply of the eyes turning upwards in winking and sleeping, and refers this to the combined action of the two obliques, neither of which, nor both together, are able, or are supposed by him, to simply elevate the eye. He is farther confused, for, although he contends that the obliques are involuntary muscles and act in winking and for expression in the waking state, he says "that in sleep, faintness, and insensibility, the eye-ball is given up to the one (the oblique), and in watchfulness, and the full exercise of the organ, it is given up to the influence of the other (the straight) class of muscles." (p. 292.)

Again, I presume that, when the cornea moves straight under the

[e] To show that, in winking, the eye turns up as the eyelids close, he mentions a case of inflammation of the cornea through the immobility of the eyes and eyelids. If the eye could have moved, the immobility of the eyelids would not have had this effect: nor would it have resulted if the eyelids only could have moved. But this case is no proof that the eye naturally turns up in winking, and that the motion of the lids alone is not sufficient to preserve the eye moist and prevent inflammation.

[f] I make the references to the paper as printed with others by him in one octavo volume, under the title of *An Exposition of the Natural System of the Nerves of the Human Body.* 1824.

upper or lower eyelid on the sudden approach of any thing to it, the motion is from fear, and as instinctive, and expressive, and *respiratory!* as any motion can be: yet it is accomplished by the superior or inferior straight muscle of the organ, — both voluntary muscles.

Not only do the motions of the straight muscles continually express the passions, but the abducent or external is actually the antagonist of the two obliques when, in Sir C. Bell's own words, "their combined action draws the eye-ball towards the nose;" just as the two obliques when acting separately are the antagonists of each other: and the circumstance of this muscle antagonising not only the internal straight muscle but the combined action of the two obliques may explain why it has a distinct nerve.

He further contends that the eye-ball moves so that the cornea always rises under the upper lid the moment that the eyelids close (p. 294.), and in some places he says it not only rises but moves inwards. (p. 328.) I have raised the upper eyelid of persons whose eyes were shut, and found the cornea sometimes raised under the upper lid, but as often depressed under the lower lid. I have often looked at persons whose eyes were closed, and seen the cornea projecting at the centre of the upper eyelid, in the same line as when the eyes were open. He states that, "if we fix one eye upon an object, and close the other with the finger in such a manner as to feel the convexity of the cornea through the eyelid, when we shut the eye that is open, we shall feel that the cornea of the other eye is instantly elevated; and that it thus rises and falls in sympathy with the eye that is closed and opened." I have made this experiment repeatedly, and not found my closed eye ascend when I closed the other: nor have my friends, who observed the cornea projecting at the closed eye, seen any ascent of it on my closing the other. Indeed, according to him, the closed eye ought already to have ascended when it was closed, and thus could not be felt or seen ascending when the other eye was closed. He says that, if, closing the eyes opposite a window and still seeing the light through the lids, we attempt to close them farther, we shall be in momentary darkness, because during the effort the eyeballs are then turning up. But there is sufficient reason for our darkness in the circumstance of the eyelids becoming thickly

folded during the attempt to close them farther. In fact, if my cornea is felt at this moment, it is found just where it was before; and the circumstance of light being seen, although the eyes were shut at first, disproves Sir C. Bell's statement, that, "at the instant in which the eyelids are closed, the eye-ball makes a movement which raises the cornea under the upper lid." He also says that, if the eyelid is prevented from closing by palsy or adhesion, the sudden approach of any thing to the eye causes the cornea to ascend. I have no doubt that it will ascend or descend, in order to get out of danger from the approaching body.

But the crowning wonder of the whole is that one of the obliques is not supplied by a nerve of the respiratory set. The superior oblique is supplied by the fourth — the pathetic or internal motor — a pair evidently of voluntary motion, but which is called by Sir C. Bell respiratory. Neither this, however, nor any other respiratory nerve goes to the inferior oblique, which is most unluckily supplied by the third only.[g] Further, the oblique muscle, which is not supplied by the fourth or any other respiratory (I am really ashamed of thus repeating the word in so absurd a sense) nerve, but by a nerve of voluntary motion, is the more important muscle of the two in turning the eye upwards and inwards. For, not only does he contend that this is its proper action (p. 312.), but that, when the superior oblique is divided and it and its nerve rendered useless,

[g] Sir C. Bell does not allude to this difficulty; but quietly advances an opinion which he may at any time adduce as his means of getting over it, should others discover it. He fancies that nerves relax as well as contract muscles; and "that the influence of the fourth nerve is, on certain occasions, to cause a relaxation of the muscle to which it goes," in which case the eye-ball must be rolled upwards. Thus the inferior oblique muscle acts because the fourth pair has relaxed the superior. The plain answer to this is, first, that the inferior oblique muscle acts not only when it is unopposed, but when the superior oblique is in action. Sir C. Bell speaks of their *combined action*, and it must move in this by the positive stimulus of some nerve. Secondly, it of course is furnished with a nerve, and this is a branch of the third — *not a respiratory pair*, but a pair of voluntary motion that supplies the straight muscles of the eye. In fact, to suppose a muscle, not belonging to a cavity or canal, to move without an exciting nerve, would be impossible; and, were such a muscle to have no nerve, its muscular structure would be useless — a merely elastic substance would have answered the purpose of lengthening under opposition and shortening when no longer stretched.

the lower gains in its power of elevating the ball, which turns upwards and inwards so forcibly as to be brought down again with difficulty by an animal (p. 314. sq.); and, although he had, throughout his paper, ascribed the elevation of the eyes, when closed, to the two obliques (p. 317.), he, at the end of it (p. 332.), ascribes the elevation to the inferior oblique only, and refers to the page in which he had ascribed it to both, as if he had there ascribed it to the inferior alone.

The straight and oblique muscles, there can be no doubt, are equally voluntary. The straight are clearly for the direction of the eyes, and we become acquainted with the distances, magnitudes, and positions of objects, by the sensations which accompany the motions of the muscles of the eye, or, in other words, from the consciousness of muscular effort. We owe this important principle to Bishop Berkeley, who, in his excellent essay on this subject [h], thus expressed himself more than a century ago: — "Now, it being already shown that distance is suggested to the mind by the mediation of some other *idea*, which is itself perceived in the act of seeing; it remains that we inquire what *ideas* or *sensations* there be that attend *vision*, unto which we may suppose the *ideas* of distance are connected, and by which they are introduced into the mind. And *first*, it is certain by experience, that when we look at a near *object* with both eyes, according as it approaches or recedes from us, we alter the disposition of our eyes, by lessening or widening the distance between the *pupils*. This disposition or turn of the eyes is attended with a sensation, which seems to me to be that which in this case brings the *idea* of greater or lesser distance into the mind. Not that there is any natural or necessary connection between the sensation we perceive by the turn of the eyes, and greater or lesser distance: but because the mind has, by constant experience, found the different sensations corresponding to the different dispositions of the eyes, to be attended each with a different degree of distance in the *object*: there has grown an habitual or customary connection between these two sorts of *ideas*: so that the mind no sooner perceives the sensation arising from the different turn it gives the eyes, in order to bring the *pupils* nearer, or farther asunder, but it withal perceives the different *idea* of distance which was wont to be connected with that sensation. Just as upon hearing a

[h] *An Essay towards a New Theory of Vision*, sect. 16. sqq. 1709.

certain sound, the *idea* is immediately suggested to the understanding, which custom had united with it." Dr. Wells, in 1792 [i], extended this principle of Berkeley's, and proved that the apparent direction also of an object which sends its picture to any given point of the retina depends upon the state of action existing at the same time in the muscles of the eye; and he adduced many and convincing proofs that it cannot be altered except by a change in the state of that action. Thus, an ocular spectrum impressed on any part of the retina does not appear to alter its position, when it is forcibly pressed aside in any direction; but, whenever the voluntary muscles act, it is referred by the mind to a different point of external space. That the apparent distances and positions of objects are suggested to the mind by sensations accompanying the motion of the muscles of the eyes, is a principle then clearly stated both by Berkeley and Wells. It has, however, by many been considered the discovery of Sir C. Bell, because he reproduced it, in 1823, above a century after Berkeley and thirty years after Wells, though he has not advanced a single original argument in its favour, and has unpardonably suppressed all reference to the philosophers by whose reasonings and researches it had been established. [k]

Prof. Wheatstone has recently made a series of curious experiments, from which it appears that the sensations which accompany the converging and the parallel motions of the eyes are so dissimilar, that it is highly improbable that these two sets of motions are effected by the same muscles. He is of opinion that the parallel motions of the eyes are governed by the straight

[i] *An Essay upon Single Vision with Two Eyes.* 1792. p. 56. sq. p. 70. sqq. of an edition of this and some other writings, with his autobiography, 1818.

[k] Let any one read Wells (pp. 55—57.) and Sir C. Bell (pp. 318—323.), and his eyes will rise most expressively, by the action, I presume, of the superior straight muscles.

Too many of the anatomical and physiological papers in the *Philosophical Transactions*, from the time of the first contributions of the glorious burner of John Hunter's precious and voluminous manuscripts to the present, reflect no credit upon those medical members of the council of the Royal Society who recommended their publication. But the poverty or errors of papers disfigure the Transactions, to my view, less than the parade of old facts and opinions as new, without the slightest reference to their authors; and this is a greater reflection upon the medical members of the council, when the real authors were distinguished Fellows of the Royal Society.

muscles, while the converging motions are regulated by the oblique. The experiments from which Sir C. Bell infers that the oblique are not voluntary muscles prove only that their functions are not the same as those of the straight muscles. If Professor Wheatstone is correct in the functions which he assigns to the oblique muscles, it is easy to see that they have an appropriate office under voluntary control, though their peculiar actions do not assist the straight muscles.

Light, like heat, is an agent by which all vegetables and animals are intended to be influenced. As the terms heat and cold are only relative, and no temperature is so low but that there might be a lower, and the plant, which lives in the snow only of polar regions, would still perish if the temperature were lower than it is; so light really exists in darkness, — no darkness might not be darker, and no plant or animal can be totally deprived of light. Deprived of light, a plant would lose its characteristic form, colour, taste, and odour, and puzzle the best botanist: persons deprived of light grow pale and sickly; but in this case, whether the place be a mine, a narrow street, or a prison, the want of fresh air, and in regard to prisoners the depressed condition of the mind, and occasionally the deficiency or bad quality of food, must also be taken into consideration: and, if pregnant women confined in dungeons often produce monsters, the state of mind cannot but be a powerful cause of the aberration. Dr. Edwards has proved that, by excluding tadpoles from the light, they will grow to double or triple the size that tadpoles usually attain, but are not metamorphosed into frogs. He thinks that the proteus anguinus, which, like tadpoles, has lungs and gills, is but the first stage of an animal which is prevented from becoming perfect by inhabiting the subterraneous waters of Carniola. He concludes therefore that light has a great influence upon the human body; and ascribes the observation of Humboldt, that, among millions of Caribs, Mexicans, Peruvians, &c., not one instance of deformity appeared, to the exposure of their body to light, and much of the sickliness of imprisoned persons and scrofulous children living in close streets to the want of light. (*De l'Influence, &c.* P. iv. c. 15.) "Vegetables, though they have no nerves, guided by light, open and close their flowers and their leaves." "In plants with compound leaflets," says Professor Lindley, "the leaflets fold together while the petiole is recurved at the approach of night; and the leaflets again expand and raise themselves at the return of day. In others the leaves converge over the flowers, as if to shelter those more delicate organs from the chill air of night. The flowers of the crocus and similar plants expand beneath the bright beams of the sun, but close as soon as these are withdrawn. The œnotheras unfold their blossoms to the dews of evening, and

wither away at the approach of day. Some silenes roll up their petals in the day, and expand them at night. The florets of numerous Compositæ, and the petals of the genus Mesembryanthemum are erect in the absence of the sun, but become reflexed when acted upon by the sun's beams." "Plants of corn, in which there is little indication of sleep when grown singly, exhibit that phenomenon very distinctly when observed in masses: their leaves become flaccid and their ears droop at night." "A flower removed from the shade will often expand beneath a lamp, just as it will beneath the sun itself." De Candolle found he could induce plants to acknowledge an artificial day and night by exposure to the light of candles. Still, Prof. Lindley remarks, there must be some other cause than light, because many flowers close in the afternoon while the sun shines on them, and the petals of others fold up under a bright illumination. (*Introduction to Botany*, book ii. chap. xii.)

Just, however, as different plants require different temperatures, and the protococcus nivalis flourishes and secretes in snow, so different plants require different degrees of light. Humboldt, near the Canary islands, saw a marine plant of a grass green brought up from a depth of about 190 feet, where the light could not have been stronger than that of a candle at the distance of a foot. He found several green plants growing in the dark mines of Freiberg; but there the atmosphere was peculiar, — charged with hydrogen or a large quantity of nitrogen; and Senebier remarked that plants do not completely lose their green colour in darkness, if they are supplied with a certain quantity of hydrogen, —an observation not verified in the experiments of Decandolle. (*Physiologie Végétale*, par M. Aug. Pyr. Decandolle. Paris, 1832. t. ii. p. 899. sq.)

Zoophytes prove themselves sensible to light; some by expanding or contracting according to its intensity, or by placing themselves on the side of a vessel where the light is strongest. One, the veretillum cynomorium, seeks the darkest places, and contracts as soon as light is admitted to it.

Most entozoa, living in the dark recesses of other animals and imbedded in what they feed upon, require no eyes, and are not known to have them. Nor the acephalous or bivalve mollusca, as the oyster, or the cirrhopodous, as the barnacle, the hind part only of which protrudes from the shell. Many minute polygastric animalcules seek and enjoy the light; and, on the front of their bodies, small red spots are generally discovered. Even monads, regarded as the lowest of animals, have them. In other infusoria these spots are united into one. These receive the impression of light only, and, as the polygastric animalcules move rapidly and prey on others, perhaps not merely light, but forms are distinguished. No nervous filament has hitherto been detected in such creatures: but, as they have impressions from an external organ, desire and will, they must have something equivalent to a nervous system. This is the first form of the eye in the larvæ of insects when the organ begins to develope, and in the young of higher animals; and, when an optic nerve is added, this is placed behind the pigment of the red spot, showing the spot to be the organ of vision. In the nais proboscidea, and many of the lower tribes of annelida, an optic nerve is added to the pigment: but nothing more is discoverable. Many of those entozoa or rather epizoa which live on the external parts of others, on the skin, eyes, gills, &c. as the ergasilus gibbus, which is attached in myriads to the gills of freshwater fishes,

have eyes, numerous or single, single originally, or several united into one, but lying flat on the surface, — sessile. So with most free annelida : in the planaria viganensis there is a single row of about forty eyes. In addition to the pigment and nerve there is a lens. In different species of gasteropoda, as the slug, snail, limpet, eyes are situated at the base, middle, or extremity of their tentacula. The eye of the helix pomatia has within its pigment a transparent semifluid substance, and even another transparent body shaped like a lens. The murex tritonis and voluta cymbrium have also an iris forming a pupil. Among the articulated animals we find the lucid spots already mentioned, called also simple eyes and stemmata; conglomerate eyes, or clusters of these; and compound eyes, or a large assemblage of small tubes each with its own humours, retina, and cornea; together with eyes supplied each with separate lenses and retinæ, but having one common cornea. Among myriapods we have examples of the conglomerate eye; in the scolopendra there are twenty contiguous circular lenses arranged in five lines, with one larger eye behind the rest, like a sentinel; in the millipede, there are twenty-eight, arranged in a triangle of seven rows, each having one eye fewer than the row above. In the larva state insects have only stemmata if they are destined for a complete metamorphosis; but, if to an incomplete, they have both compound and simple eyes. Some zoophytes, being free in one state have eyes, which they lose on being metamorphosed and no longer free, when eyes would be useless. Except some parasitic insects and five species of ants, all insects have compound eyes, generally one on each side of the head, forming a globular mass of from fifty to some thousands, even twenty or thirty thousand minute eyes closely pressed together, and placed on a central bulb which is a part of the optic nerve. They are cylinders or cones, while their external part or cornea is the base, usually hexagonal, like the cells of a honeycomb, because this form allows uniformity of arrangement with the greatest economy of space. The united bases or corneæ are an hemispherical convexity; under each cornea is an almost conical lens. Each cornea is covered by smooth epidermis, just as our cornea is covered by conjunctiva, with its apex backwards, towards the nerve, and a portion of chorioid pigment lies between the cornea and lens, with an aperture in the centre, constituting a rudimentary iris, which in the grey dragon fly has been seen to contract and dilate; and between it and the cornea are a little space and a drop of aqueous humour. The pigment runs backwards around the lens, separating each cylindrical compartment. The apex of the lens is met by the end of a filament of the optic nerve, running through a vitreous humour; and Dr. Wollaston found the focal distance to correspond accurately with the length of the tube, so that an image falls exactly upon the retina. These multiplicities of corneæ in all directions compensate for the want of sensibility in the eyes of insects. There are often simple detached sessile eyes also, equally motionless: and the purpose of the presence of both kinds is unknown. There is no apparatus of defence, — no eyelids, eyelashes, or tears, except that hair sometimes grows from between the corneæ; and these are compensated for by the great hardness and insensibility of the cornea, which allows it to be brushed with the hairs of legs or other moveable parts. Branches of a trachea have been traced into each kind of eye. In the arachnida the optic nerve expands into a cup-like form behind a hyoloid membrane and vitreous humour.

The eyes of crustacea are compound and immoveable except in the higher orders, in which they are placed on peduncles and moved by muscles; and one crab has the peduncle jointed at one spot, so that the eye can be moved in various directions, like the arms of a telegraph. In those crustacea which are called monoculi, the eye is of the fourth class,— many lenses behind one cornea, and placed in a socket, in which muscles exist for its motion. Allusion has been already made to the eyes of mollusca. When they can be useful they exist, but are always simple and solitary; they have always a lens, and approach very closely to the eyes of fishes and higher vertebrated classes. The sepiæ, indeed, besides a large and very convex lens, exceedingly hard at its centre, have a hemispherical vitreous humour, a chorioid, an iris with a kidney-shaped pupil, but no cornea, the integuments of the head being continued over the iris, reflected upon the edges of its pupil, and covering the external surface of the lens.—Fishes have eyes similar to the sepiæ, but possess a cornea, which, as in all aquatic animals, on account of the small difference there can be between its refractive power and the water they inhabit, however great its convexity, is nearly flat. They require no aqueous humour, except a little to preserve the iris free. The vitreous is not a body of sufficient density to be very important. The globe is hemispherical, the lens nearly spherical and very dense, and more and more so towards its centre. It consists of concentric layers of fibres, the fibres of each layer being serrated and locked into another side by side. The pupil is large, and the iris nearly motionless. The outer shining layer of the chorioid passes over the front of the iris and gives it a pearly lustre; the dark inner layer lines its posterior surface. Their situation renders all eyelids and lachrymal apparatus superfluous; and they have only a covering of the common integuments over the cornea. The sclerotic is of extraordinary thickness and hardness, and contains fat between itself and the retina. As fish live in a dark medium their eyes are large, particularly if they live 300 or 400 fathoms below the surface. The eyes of fish which burrow in mud are small; sometimes rudimental or imperceptible. The optic nerves sometimes decussate, sometimes simply lie across each other, sometimes one passes through a hole in the other. Amphibious reptiles, being destined to live on land and in water, have eyes intermediate between those of fish and of land animals. Their eyes are large, possessed of little aqueous humour, and therefore the cornea is comparatively flat, especially in those which are the most in water; the lens is thick in the direction of the axis of the eye; as they are sometimes out of the water they have eyelids, the lower larger and more moveable than the upper, together with a third eyelid or membrana nictitans. In land reptiles, the structure recedes from that of the eye of fishes and approaches to what is observed in birds; the cornea is more convex, the aqueous and vitreous humours more abundant, and the lens less spherical; two moveable eyelids, a membrana nictitans, straight and oblique muscles, and a lachrymal apparatus exist. In some ophidian reptiles, as serpents, the skin of the eyelids passes over the eyes and their appendages, and this portion of it is therefore shed with the rest: one small tribe of them, comprehending eels, have a membrana nictitans like saurian reptiles. In some chelonian reptiles, as the tortoise and turtle, and some of the saurians, as the crocodile, a circle of imbricated plates of bone is seen at the fore part of

the sclerotic, and supports the iris: within the sclerotic of some there is fat. In the gigantic ichthyosaurus, which formerly inhabited the ocean, but is now extinct, the same is found. The chamelion has very projecting eyes, to which the light is admitted through a minute vertical slit in the skin, which forms but one lid, the upper and lower being united; and each eye can be turned in a variety of directions independently of the other: there is also a membrana nictitans nearly as large as in birds.

The wonderful adaptation which is observed throughout nature, in the most minute point, to the purpose for which every thing was intended, presents us in birds with eyes the most remote in form and structure from those of fishes, and exactly fitted for the rare medium which they inhabit; the difference between which and the aqueous humour of the eye is so great, that this is sufficient to refract the rays of light powerfully. The aqueous humour is, therefore, so copious that the cornea, which is thin, is very convex; and, to prevent the sclerotic from being unduly expanded, and the prominence of the cornea lost, a circular series of fifteen or twenty quadrangular, moveable, imbricated bony plates are placed around its edge, between the two plates of the sclerotic: from being imbricated, they are much less liable to fracture than a bony ring. The tough posterior part of the sclerotic forms a large hemisphere almost occupied by the abundant vitreous humour; while the lens, not being so requisite for refraction, is flattened, smaller, and less dense. The iris and lens are necessarily at a great distance from the cornea, by which arrangement the refracting powers are susceptible of great variation, and the animal sees well at the most different distances. Not only were these powers necessary, but a large field of vision; and therefore the cornea is very prominent, and the eyes of great size compared with the head, and placed laterally upon it. Yet they are less moveable than in quadrupeds; but the reason of this is the length of their neck and extreme mobility of their head. The chorioid coat, lined with a black pigment of globules with a transparent centre, sends a prolongation called marsupium or pecten, puckered and folded, from the entrance of the optic nerve through the vitreous humour, and to the capsule of the lens, for some purpose unknown, unless it be to supply copious vessels for secretion, to darken the eye in the blaze of the sun, or, if muscular, to affect the shape and position of the lens, and thus adapt it for vision in great variations of distance. The iris has various bright colours, and is wonderfully mobile, and thought to be voluntary, in parrots. The membrana nictitans, or moveable semitransparent fold of the conjunctiva at the inner corner of the eye, is of great size and moved by two strong muscles in order to keep the tears constantly diffused over the eye in the rapid course of birds through the air, and to protect it fully against sudden light. It returns to its place by mere elasticity. We have a rudiment of it in our own inner canthus. The eyes of mammalia agree generally with our own; but, as some of this class fly, some inhabit the water, some are amphibious, and some burrow in the dark, they are necessarily of great variety. They are generally small in those bulky animals whose food requires not to be discovered at a distance, as the elephant, rhinoceros, and hippopotamus: the eye of the elephant is not above two inches in diameter; of the whale, not above the 200th part of the length of its body. They are small in moles and shrews; so small in the mole, that Dr. Magendie

denied the existence of an optic nerve in this animal.* In the zemni, or blind rat, the integuments, overspread with hair and of uniform thickness, cover the whole side of the head, and under it a black spot only is found, a mere rudiment and useless. In these cases, the sense of hearing is extremely acute; and both it and other senses in the bat, which has very small eyes, though a nocturnal animal. For those which prey by night, as well as those which have to see at a distance in order to pursue or avoid pursuit, as the carnivora, rodentia, and ruminantia, have large eyes. The pupil is transverse in many ruminants whose head inclines downwards, so that they can see extensively to the side and backwards when feeding: while in those which spring from a height, or climb, it is frequently perpendicular, so that their vision is extensive upwards and downwards. In almost all the inferior tribes, just as is generally the case in fishes, reptiles, and birds, they are placed laterally in the head, with two independent fields of vision, the optic axes forming a very obtuse angle together, so as to give a very large view. As we ascend towards the quadrumana, the optic axes form a smaller angle,— the two fields of vision approach, so that both eyes can be directed simultaneously to the same object; and the same is noticed in nocturnal quadrupeds, and in owls; and in us the axes are more nearly parallel than in any other mammalia, the fields of vision coincide in almost all their extent, and precision of visual impressions is thus augmented. In carnivorous quadrupeds, the back

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* Not only did Dr. Magendie deny this, but M. Serres, doing the same thing, declared that the mole and several others saw by means of other nerves than the optic, and thus argued that one part of the nervous system could perform the functions of another. "The sense of smell," says he, "can be transported from one nerve to another, according to the ingenious remark of Professor Duméril. From the observations of Scarpa, Cuvier, Jacobson, and Treveranus, hearing may be partly performed by the fifth pair. From my researches on the mole, chrysochlore, shrew mouse, zemni, proteus, &c., these animals see by some other nerve than the optic. Is it not such facts as these that gave M. Cuvier the idea of the general law which he has stated, of the difference of the functions of nerves depending rather upon the different organisation of the parts to which they are distributed, than upon their own nature." Gall observes that M. Serres must have forgotten the remark in his treatise on the difference of nerves (*MON traité sur la différence des nerfs*, in his 4to work, t. i. p. 127.), that Cuvier disavowed this idea in his *Comparative Anatomy*, p. 492., where he says, "analogous parts constantly receive their nerves from the same pair in all animals, whatever be the situation of the parts, however circuitous the course which the nerve has to take. Analogous nerves have always a similar distribution: always go to the same parts. Even those small pairs whose distribution is the most limited, and which might easily be supplied by others, as the fourth and sixth, preserve their existence and office." Gall then states that he has examined the mole and found an optic nerve, though extremely small; and adds that M. Baily has confirmed his observations, and demonstrated the nerve to St. Hilaire and Cuvier. Naturalists now agree with Gall. (Gall, l. c. 8vo. t. vi. p. 307. sqq.)

part of the chorioid has not the black pigment of other parts, but a pigmentum lucidum or a tapetum, shining with a blue or green metallic lustre. In mammalia, to compensate for the smaller extent of motion in the head, the eye has more means of motion than in birds. In aquatic mammalia, the eye has many affinities with the structure of the organ in fishes. In cetaceous animals, for example, the cornea is flat, the aqueous humour inconsiderable; the lens large, dense, and spherical. Intermediate forms of the organ are observed in the semi-aquatic, — the walrus, seal, beaver, otter. "Thus," says my able colleague, "we observe these complicated optical instruments, the most universal and the noblest organs of sense, gradually advancing to perfection from the monad to the man, where all their internal essential parts, and all their external accessory apparatus, are the most exquisitely finished and adjusted; and it is chiefly through these means that he is enabled to provide for his wants, to acquire the materials of thought, and to enjoy the sublime spectacle of nature." — Dr. Grant, ll. cc. See also Dr. Roget, l. c.

CHAP. XXVII.

SLEEP.

"The faculties both of feeling and motion, possessed by the" brain, "are so fatigued by their exertions in the day, that rest is necessary during the night to recruit them by means of *sleep*[a] — the image of death," as it has been termed; for in it we cease to be cognisant of the world around and of our own existence, and lie motionless. Mechanical contact, temperature, savours, odours, light, and sound are no longer felt unless strong; nor the internal feelings of hunger, thirst, &c.; thought ceases, and, from the general suspension of volition, gravity, no longer opposed by contracted muscles, produces its full effect, the head falls forwards or to one side, the upper eyelid, the lower jaw, the extremities drop, and the body sinks, as far as circumstances allow it, into the horizontal posture. This state may come on in a moment, or in a more or less gradual manner, and it may come on gradually for a time and at length suddenly. If gradually, we feel tired; find attention and muscular volition more and more difficult, so that we imperfectly understand what we are hearing, reading, or thinking of, or what is passing around us: we speak slowly, imperfectly, and unconnectedly, till we cease to speak at all; we desire to think, perceive, and make the least exertion, no longer, — are drowsy. If at the same time we have a reason for keeping awake, we make great and repeated efforts to open our eyes, to elevate the lower jaw, and to raise and balance our head and trunk, perhaps to the great amusement of others: we take

[a] "Consult, besides authors hereafter to be recommended, Dr. Darwin, *Zoonomia*, t. i. Sect. xviii.

And Wienholt, *Heilkraft des thierischen Magnetismus*, vol. ii. p. 437. sqq.

Fr. Aug. Ammon, *Commentatio præmio regio ornata de somni vigiliarumque statu morboso.* Gott. 1820. 4to.

C. Fr. Heusinger, *De variis somni vigiliarumque conditionibus morbosis.* Isenac. 1820. 8vo."

But particularly Dr. Robert Macnish, *The Philosophy of Sleep*. Ed. 2. Glasgow, 1834.

the easiest position in our power, — that which approaches the nearest to the horizontal, so that we may have to make no muscular effort; we gape, and yawn; a degree of delirium [b] is experienced, from the impaired condition, short of suppression, of our feeling and attention. This delirium or wandering when we are between sleeping and waking is a much surer sign that we are about to get to sleep than the consciousness of the greatest drowsiness. A heaviness of the upper eyelid; smarting of the eyes, such as to give rise to the common remark to a sleepy person, that the dustman has thrown dust into them; peevishness, especially in children; chilliness; also precede sleep that does not come on suddenly. The breathing grows slower in two respects, — as to the intervals of the respirations and as to inspiration, and on this very account it becomes deeper, and takes place with increased sound: and in adults snoring is a common occurrence during sleep, and takes place if the inspirations are forcible, and if circumstances favour an open state of the mouth, so that the velum palati, being relaxed, is thrown into vibrations by the passing air, or if more or less of the tongue lies up against the palate, so that the nose is made to vibrate; and if the mouth is closed, palatal snoring will still occur should a portion of the tongue touch the palate, and snoring will be more and more nasal the greater this portion of the tongue. Like the respiration, the pulse grows slower and fuller. To exclude the light as much as possible, the pupil becomes contracted, and the eyes sometimes turn up or down. The temperature falls somewhat. The transpiration is found to increase; and, when persons are weak, this is shown by its occurring frequently to the amount of sweating as soon as ever they fall asleep. From this circumstance, and the cessation of drinking, less urine is secreted; and, from the motionless state of the lower jaws and tongue, and the absence of food from the mouth, there is less saliva and oral mucus; from the absence of light and the quiet state of the eyes and eyelids, less lachrymal secretion. But, except from such absence of stimuli which act in the waking state, I doubt whether secretion is lessened in sleep: that it is not necessarily lessened, is shown by the increase of perspiration. Dr. Macnish

[b] "De Pauw has some singular observations upon it in his *Recherches sur les Egyptiens et les Chinois,* t. ii. p. 1[illegible]."

contends that all other secretions are lessened, — the nasal, bronchial, and intestinal. The nose is certainly not blown during sleep; but only because we do not perceive its charge of mucus: on awaking, however, we find a handkerchief useful. In pulmonary affections there may be no expectoration during the night, but then a large quantity is discharged on waking. Diarrhœa may not disturb a patient while asleep, but a copious evacuation is common in this disease early in the morning. With the chaste of either sex, genital emission is common during sleep. In the morning the mouth is foul and the eyes gummy. But these circumstances probably arise from the lessened amount of the respective secretions from the lessened excitement, so that evaporation concentrates them.

The circumstance of our resisting sleep as long as we can keep our eyelids open, and falling asleep, when very sleepy, the moment we allow the eyelids to drop, is very striking, but explicable on the continuance of voluntary effort in the former case, and cessation of it in the latter.

There is less resistance to the cooling power and morbid effects of cold and injurious agents during sleep. Therefore persons cover their heads before going to sleep; and, when habit has not overcome the necessity for this, cold is continually caught from its neglect. A draught of air is far more dangerous in the sleeping state; and the back of the body appears less vigorous than the front, as a draught at the back is much more dangerous than in front. Agues are caught more readily if persons fall asleep.

In the healthy state, we awake refreshed with sleep, —

> "Tired nature's sweet restorer, balmy sleep." [c]

The transition from the sleeping to the waking state may, like the opposite, be sudden: but generally it is slow.[d] When sudden,

[c] Young's *Night Thoughts*.

[d] Milton exquisitely represents the slow approach of Adam's first sleep as causing him to imagine his existence was departing: —

> "Pensive I sat me down: then gentle sleep
> First found me, and with soft oppression seized
> My drowsed sense, untroubled, though I thought
> I then was passing to my former state
> Insensible, and forthwith to dissolve."
>
> *Parad. Lost*, b. viii.

a few moments are required for us to recover from our surprise and find we are awake. When slow, we for a little while are sleepy, gape and yawn, but half open our eyes, scarcely perceive what is around us or understand what is said; and have imperfect power over the muscles, so that we stagger and perform all movements awkwardly: and, if still slower, the same delirium is experienced as while going slowly to sleep, and for a little longer we are still sleepy.

Sleep appears much more profound at the beginning than towards the end, and, I presume, because the fatigue is then greatest and gradually lessens as sleep continues. In the same manner, transpiration, we have seen, is at first greatest, and gradually lessens as the body loses its excess of fluid; and absorption gradually lessens as the body becomes charged with fluid.

In some diseases of the nervous system persons may pass many days, and even entire weeks, with little or no sleep. I have known this sleeplessness to be the only disease, and recur on several occasions in the same individual: usually after excessive corporeal or cerebral excitement. Great wretchedness, debility, and restlessness of body and brain took place.

The duration of sleep is various. Youth and young adults will habitually sleep soundly and uninterruptedly for eight or nine hours. Infants and old people sleep for shorter periods. Some persons are constitutionally sound and long sleepers: others light and short sleepers. Infants sleep far more in the twenty-four hours than adults: when very young, having but recently come into the waking state from the womb, they are awake but for short periods; and for very many months require to go to sleep several times, and for the first two or three years more than once, in the twenty-four hours. Old people sleep lightly and frequently; and altogether but little, unless lethargic disease comes upon them, which is very common.

I heard Baxter the coachmaker declare he never took more than three hours sleep during the most active period of his life. "The celebrated General Elliot"—" never slept more than four hours out of the twenty-four; and his food consisted wholly of bread, water, and vegetables." Sir John Sinclair mentions a James Mackay, "a remarkably robust and healthy man," "who died in Strathnaver in 1797, aged ninety-one, and only slept, on an average, four

hours in the twenty-four."—"Frederic the Great," as he is called, and the truly great John Hunter, "slept only five hours in the same period." Dr. Macnish, to whom I am indebted for these instances, says, "I know a lady who never sleeps above half an hour at a time, and the whole period of whose sleep does not exceed three or four hours in the twenty-four, and yet she is in the enjoyment of excellent health."[e] Sir Gilbert Blane states that General Pichegru informed him that, "in the course of his active campaigns, he had for a whole year not more than one hour of sleep, on an average, in twenty-four hours."[f] Sleep varies so much in intensity that a *dead* sleep of an hour may be an equal repose to an ordinary sleep of many hours. The celebrated De Moivre slept twenty hours out of the twenty-four; and Thomas Parr latterly slept away by far the greater part of his existence.[g]

We read that some persons have been able to sleep long whenever they wished. "Such," says Dr. Macnish, "was the case with Quin, the celebrated player, who could slumber for twenty-four hours successively." And "Dr. Reid could take as much food and immediately afterwards as much sleep as were sufficient for two days."

Independently of apoplexy, we have cases of extraordinarily long sleep. A woman in Henault slept seventeen or eighteen hours a day for fifteen years.[h] Another is recorded to have slept once for forty days.[i] A man named Samuel Chilton, twenty-five years of age, at Tinsbury, near Bath, once slept for a month: in two years he slept again for seventeen days, at the beginning of which period he took food, and had evacuations, but at length his jaws fixed: when he fell asleep the barley was sowing, and when he awoke he would hardly believe he saw it reaping: at the end of a year he fell into such another sleep: his farther

[e] l. c. p. 33. sq. He refers to Gooch for the story, which he very properly disbelieves, of a man, who "enjoyed good health and reached his seventy-third year," and yet "slept only for fifteen minutes out of the twenty-four hours; and even this was a kind of dozing and not a perfect sleep."

[f] *Medical Logic*, p. 83. 2d edit.

[g] Dr. Macnish, l. c. p. 35.

[h] *Medical Observations and Inquiries*, vol. i.

[i] Plott's *Natural History of Staffordshire*.

history is not given.[k] Mary Lyall fell asleep in the morning of the 21st of June, and did not awake till the evening of the 30th, and slept again the next day till the 8th of August, remaining motionless and without food from the first till seven days had elapsed, when she moved her left hand and pointed to her mouth, in consequence of which food was given her, which she took during the rest of her sleep: she heard nothing; and, though she instantly drew back her left hand when touched with the point of a pin, the right might be scratched till it bled without pain: she was bled, blistered, and plunged into cold water without sensation: her pulse for the first two weeks was generally 50; during the 3d and 4th about 60; and the day before she awoke 70 or 72: her breathing was almost imperceptible, but in the night occasionally strong as in a person asleep: she gave signs of hearing about four days before she awoke; and afterwards recollected nothing that had occurred in her attack,— neither the blistering, bathing, nor eating; and had the idea only of having passed a long night in sleep.[l]

A lady at Nismes would sleep from sunrise, whatever the season of the year, till near noon; and again immediately after noon, not waking till between seven and eight at night; but she now remained awake till sunrise. If the attack lasted six months, she was free for six months; if for twelve, she was free for twelve. The affection gradually declined, so that she lived free from it many years, and died at eighty-one.

Dr. Macnish mentions one "Elizabeth Orvin, who spent three fourths of her life in sleep."

In hysteria, I saw a young lady who slept for six weeks and recovered: and her twin sister had slept for a month; but, whether from not being well supplied with nourishment and warmth I cannot say, she died before I saw her, and on inspection nothing but inanition and bloodlessness was found.[m]

Elizabeth Perkins, in 1788, fell into a deep sleep from which nothing would rouse her: at the end of eleven days she spontaneously awoke, and went about as usual; but fell asleep again in a week, remained so for some days, and, with occasional intervals

[k] *Phil. Trans.* 1694.

[l] *Transactions of the Royal Society of Edinburgh*, 1818.

[m] See my clinical lecture in the *Lancet*, March 12. 1831.

of waking, dozed for several months and died. A poor paralytic man at Kirkheaton, twenty years of age, was seldom awake more than three hours in the twenty-four for a year: once he slept for three weeks, breathing calmly, but incapable of being roused and of eating or drinking.

A lethargy of several days before apoplexy is sometimes observed. Some are constitutionally or temporarily very susceptible of the influence of soporifics. I have seen a person destroyed by a single dose of a third of a grain of muriate of morphia; and two or three from a grain, although they had recently taken doses of half a grain, and even a grain, with little effect. Again, in morbid irritability, as in delirium without strength, large quantities are borne. I have seen a grain of muriate of morphia, after its exhibition in more distant doses, taken every hour for forty-eight hours, with not the least effect. Sometimes, without dying, persons remain a long time asleep after soporifics. Dr. Macnish refers to a child, near Lymington, that was thus sent to sleep for three weeks.

I believe that most adults require from six to eight hours sleep. Some require nine or ten. In proportion to the exhaustion is sleep required. Therefore in debility, as after a severe disease, convalescents, though making no cerebral or muscular exertion, sleep a great deal, and find the utmost invigoration from it. The longer the waking state is protracted the greater, both absolutely and proportionally, is the exhaustion, whence one advantage of early hours, which is expressed by the adage,—one hour's sleep before twelve is worth two after. If a person rises proportionally late, he certainly cannot suffer from this course; and if he suffers, it must be ascribed, provided there is no debauch in the case, to his loss of the influence of so much solar light and morning air. One of our judges, Lord Mansfield, is said to have questioned every very old person who went into court respecting his habits: and found that some had lived in towns, some in the country, some were hard livers, some temperate, and all agreed in only one point,—that of having been early risers through life. I, however, have known several very old persons who had always sat up late, though not in vicious indulgence, and risen late.

The Rev. Mr. Wasse, rector of Aynho in Northumberland, ascertained, in a variety of instances, that we are nearly an inch taller on rising in the morning than on going to bed; and the

fact is explained by the intervertebral substances recovering their elasticity during the removal of pressure in the night.[n]

Too much sleep produces headach, heaviness, and dulness: too little, feebleness, intellectual and muscular; thinness; indifference of the feelings, so that elephants are tamed by being prevented from sleeping; headach, and various unpleasant feelings in the head, chilliness and feverishness, and at length an inflammatory state of the brain. Studious young men too frequently disregard the law of nature, — that a certain quantity of sleep is requisite for cerebral and general vigour. They fancy that far less sleep than people usually take is sufficient; and instead of eight hours, which most require, especially in youth, take but six, or even fewer. The result of this is sooner or later felt severely; study becomes more and more difficult, and, at last impossible; constant uneasiness, tension, pain, heat, throbbing in the brain are experienced; perhaps sleep becomes very difficult; general weakness is felt, and too often inflammation of the brain, or typhus, occur, or some other disease, the causes of which would have been inoperative but for the exhausted and excited condition of the system to which they were applied. So many of the best of our young men fall into these circumstances every winter, and thus, if they happily do not die, lose eventually more time than they had stolen from sleep, to say nothing of the minor efficiency of their exertions while they can study than if they thoroughly refreshed themselves by a natural allowance of repose, that I find it a duty earnestly to point out this at the beginning of every session in University College; to urge that all excess, however free from vice, and even if it proceed from virtuous feelings, is followed by bad consequences; and I can with truth add that such is the industry and thirst for knowledge and intellectual distinction, such the correctness and good feeling of the very large majority, that I never spend more than a moment in guarding the freshmen against idleness, vice, and bad practices. There can be no question that study after repose is more efficient than before it. The brain must be more vigorous when refreshed than after the excitement of the day. Many prefer night study, and in the winter it is more convenient; but, in the

[n] Dr. Macnish, p. 38.

summer, early study is equally convenient; and those who have acquired the habit of night study have only to persevere in retiring early, and rising at a fixed early hour, and they will after a time find the morning sun tell better than the midnight oil. Some commit the error of rising very early, without going to bed proportionally soon: and the result is of course the same as if they sat up late and rose at ordinary hours; they go about weak, feverish, and stupid the whole day, and are absolutely knocked up in the evening.

The effect of too little sleep upon the face is very striking: sailors, who have their rest broken at short intervals, acquire an old look.

The power of habit over sleep is very great. Within certain limits it will lessen or augment the amount of sleep necessary; but these limits differ constitutionally in different individuals, and must be influenced by the habitual amount of exertion. Any one may acquire the habit of dividing his sleep, so as to take less at night, and a portion previously in the day or evening. Some become accustomed to have their rest broken at short intervals, and able to sleep directly they wish: they acquire the habit also of waking on the least noise; that is, of sleeping very lightly. "Seamen and soldiers on duty sleep when they will and wake when they will. The Emperor Napoleon was a striking instance of this. Captain Barclay, when performing his extraordinary feat of walking a mile an hour for a thousand successive hours, obtained at last such a mastery over himself, that he fell asleep the moment he lay down." [o] By habit we wake invariably at a certain hour, however late we may retire; until, by repeatedly retiring late, the system greatly feels the want of rest: on the other hand, a person accustomed to go to sleep at a certain hour, may oversleep himself in the morning, but becomes drowsy at his usual time in the evening. Habit enables us to sleep in unfavourable circumstances. "An old artilleryman often enjoys tranquil repose while the cannon are thundering around him: an engineer has been known to fall asleep within a boiler, while his fellows were beating it on the outside with their ponderous hammers; and the repose of a miller is no wise incommoded by the noise of his mill."—"It is common for carriers to sleep on

[o] Dr. Macnish.

horseback, and coachmen on their coaches."[p] "Nay, silence itself may become a stimulus, while sound ceases to be so. Thus a miller being very ill, his mill was stopped that he might not be disturbed by its noise; but this, so far from inducing sleep, prevented it altogether; and it did not take place till the mill was set a-going again. For the same reason, the manager of some vast iron-works, who slept close to them, amid the incessant din of hammers, forges, and blast furnaces, would awake if there was any cessation of the noise during the night."—"A person who falls asleep near a church, the bell of which is ringing, may hear the sound during the whole of his slumber, and be nevertheless aroused by its sudden cessation[q]:" and a person, sent to sleep in a church by a stupid sermon, generally awakes as soon as the preacher's humdrum is at an end.

The ordinary cause of sleep is fatigue. The activity of the day exhausts the powers of the brain—feeling, understanding, and will, and the brain sleeps. The greater, in point of duration or intensity, the activity, the greater the disposition to sleep, unless the exhaustion has produced aching or irritation, — morbid conditions, which, destroying the course of health, may prevent sleep. It matters not whether the activity has been volition, passion, sensation, or reflection. Exhaustion of one part of the encephalo-spinal system exhausts the rest: nay, so bound up together are all parts of the body,—the brain and the rest, that fatigue of the brain exhausts all other parts, and fatigue of any part will impair the powers of the brain, and great muscular exertion therefore of any voluntary part exhausts the vigour of the mind. No one thinks well who is fatigued by exercise, and nothing causes sleep at night more than good exercise in the day. All studious men, who are real thinkers, require a large allowance of sleep; and find a great difference in the soundness and urgency of sleep after a day of intellectual labour, and a day accidentally spent in the shallow prattling and reading common to the greater part of the more expensively, but not better, educated persons who fancy themselves to possess cultivated understandings; or in the performance of what is the daily routine of the majority of popular, and probably fashionable, practitioners, who are destitute of sound knowledge and strangers to reflection and study, and yet impu-

[p] Dr. Macnish. [q] Dr. Macnish.

dently assume the highest importance, and disparage those who read, observe, and reflect, and are anxious to advance the general good rather than their own little interests. The exhaustion being greater before sleep has remedied it, the beginning of sleep is necessarily the soundest part, and persons are less easily roused at the early part of the night; and, after sleep, light at first finds the eyes so sensible that it is disagreeable. Emotion, continued and at length wrought up to the highest pitch, will induce sleep: whence persons condemned almost always pass the night in sound sleep before the morning of their execution, and generals sleep on the eve of their great battles. Severe pain, or a too vivid sensation, leaves drowsiness. Exhaustion of the brain by defective support of its nutritive functions equally produces sleep as over exertion of its functions. Loss of blood, purging, starvation, cold, diseases that impair nutrition or cause exhaustion by general excitement, produce sleep, perhaps coma; young infants and old people frequently require stimulants and nutriment to rouse them from coma. Cold will induce a fatal sleep; yet, if the cold is not powerful enough to produce torpor, it will keep a person awake by the disagreeable sensation. Every one must have been unable to sleep from not having sufficient bed-clothes on a cold night; and cold feet frequently prevent repose.

Defective moral and intellectual excitement incline to sleep: stupid and passionless people are generally great sleepers, and a good method of getting to sleep is to think of nothing, — to turn aside from every thought that presents itself on the pillow. The withdrawal of all causes of sensation powerfully contributes to sleep: and all animals, when inclined to sleep, place themselves in a position which shall require no exertion of volition, and retire from and exclude as much as possible all external excitement.

The excitement of the brain may be reduced and thus sleep brought on by impressions on the senses just sufficient to withdraw attention from every feeling and thought, and yet insufficient to maintain much activity. A discourse stupid or delivered monotonously, a dull book or one not understood, is pronounced sleepy from its effects; the murmur of a rivulet and the hum of bees; the sight of any thing waving, as of a field of standing corn or of the hand drawn up and down before the face by a mesmeriser, attracting attention much more than an

object at rest and yet exciting but little; induce sleep, the former acting by the ear, the latter by the eye; and gentle friction is equally effectual by means of touch. I know a lady who often remains awake in spite of every thing till her husband very gently rubs her foot: and, by asserting to a patient my conviction that the secret of an advertising *hypnologist* whom I allowed to try his art upon the sleepless individual, and which he did for a time successfully, was to make him gently rub some part of his body till he slept, he confessed this to be the fact. Boerhaave acted on the same principle in regard to another sense, when he directed water to be placed near a sleepless patient, so circumstanced that it might drop into a brass pan. Gentle motion acts by an impression on the same sense; and a combination is of course still more effective, whence experience has taught nurses to rock, and otherwise gently agitate infants, while they hum them to sleep.

Most of the substances termed narcotic have a property of inducing sleep and stupor; they have the property of inducing also giddiness, confusion, headach, delirium, and heat and throbbing: but some narcotics produce few or more of the other effects rather than sleep. Narcotics lessen sensibility throughout and indeed affectibility, possessing a general hostility to all vital properties. Yet many, if not all, stimulate in moderate quantities. Opium augments the pulse and the heat, even in the head; excites the intellect and feelings; gives headach; and renders noise intolerable: strychnine causes tetanic spasms: tobacco excites sneezing: very many narcotics occasion smarting and burning.

Impure air appears narcotic and disposes to sleep. Heat has the same power, probably by relaxing; for a certain proximity of particles, and as it were tension of structure, is indispensable to vigour and activity. Heat may also act by overcharging the head with blood, partly through relaxation of vessels, partly, as some think, by expanding the blood itself. Whatever overcharges the head, as the reversed erect posture, has the effect of causing heaviness and stupor; and thus by lying flat on a revolving millstone, with the head towards the circumference, the centrifugal force accumulates blood in the head sufficient to produce sleep and at last apoplexy. Whatever else than blood compresses the brain has the same effect; for instance an accumulation of serum, depression of bone, and, when the bone has been deficient in an individual

through accident, pressure upon the brain with the hand at once sends the person to sleep. A full meal causes drowsiness as long as the food is in the stomach, perhaps from the great activity of the organ, so that, from the general sympathy, the brain among the rest is drained of its power: some ascribe a little to the more difficult expansion of the chest, and consequent accumulation of blood in the head. Fat and plethoric people are drowsy, and in them there is excessive fulness of the blood-vessels of the head from plethora and from the obstruction produced by difficult respiration.

The causes of waking are the opposite of those of sleeping. The accumulation of vigour gradually proceeds while sleep lasts, till the brain is spontaneously active again. But, before this, we may awake from an external excitant, to whatever sense it may be applied; from any internal causes of feeling, mental, or in the body at large; or from excitement having been so strong before sleeping that the brain will not remain torpid; from excitement of the nutritive functions of the brain, its circulation, evolution of heat, &c.; from the agency of certain substances which possess the property of keeping the mind active, as tea, coffee, which may prevent sleep altogether or cause it to be short.

The proximate cause of sleep or the condition of the brain in it has been variously viewed. Some have fancied the brain compressed, and compression will disqualify the brain for its functions and cause sleep, even coma, apoplexy, and death: but there is no proof or even probability of this in ordinary sleep. Blumenbach says, he thinks that sleep "probably consists in a diminished or impeded flow of oxygenated (arterial) blood to the brain; for that fluid is of the highest importance, during the waking state, to the re-action of the sensorium upon the functions of the senses and upon the voluntary motions.[r]

[r] "Those who wish to know and compare other opinions upon the causes of sleep, may consult,

M. de Grimaud, *Mémoire sur la Nutrition.* Petersb. 1789. 4to. p. 194.

H. Nudow, *Versuch einer Theorie des Schlafs.* Königsberg. 1791. 8vo.

Steph. Gallini at the end of his *Saggio d'Osservazioni sui nuovi progressi della Fisica del Corpo Umano.* Padua. 1792. 8vo.

Mauduit, in Fourcroy, in the *Médecine Eclairée, &c.* t. iv. p. 273.

T. Chr. Reil, *Functiones Organo Animæ Peculiares.* Hal. 1749. 8vo. p. 108.

"The influx of blood," he continues, "is diminished by its derivation from the brain and congestion in other parts; it is impeded by the pressure of foreign matter upon the brain, whether from serous or purulent collections, from depression of fractured bones, &c."

"Besides other phenomena which accord with this explanation, especially those of hybernating mammalia[s], is a very remarkable one which I witnessed in a living person whose case was formerly mentioned, — that of the brain sinking whenever he was asleep, and swelling again with blood the moment he awoke.

"This opinion is likewise strengthened by the production of continued watchfulness from congestion of blood in the head."

Now it is certain that the supply of arterial blood to every part, and especially to the nervous system, is requisite to its functions and its life, and that in proportion to the activity of a part is the activity of its supply of arterial blood. Analogy, therefore, renders it extremely probable that, during the inactivity of sleep, the brain, having less occasion for arterial blood, has a less vigorous circulation than during the waking state; and we know that whatever diminishes the ordinary determination of blood to the brain, or impairs the movement of the blood through it[t], disposes to sleep. But, although this be

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L. H. Chr. Niemeyer, *Materialien zur Erregungstheorie.* Götting. 1800. 8vo. p. 71.

Troxler, *Versuche in der Organischen Physik.* p. 435.

Brandis, *Pathologie,* p. 534."

Cullen, *Physiology,* p. 124. sqq.

Adelon, *Physiol.* t. ii. p. 292. sqq.

Dict. des Sc. Méd. t. xix. p. 343. sqq.

Bourdon, *Principes de Physiol.* l. 6. p. 785. sqq.

[s] "*v. c.* Of the alpine marmot, of which Mangili treats in Reil's *Archiv.* vol. viii. p. 466. sqq.

[t] As arterial blood when at rest acquires the venous character, and the slower its motion the greater is its tendency to assume this character, it is evident that in congestion of blood, by which is meant simply an unusual quantity of blood in the vessels of a part, not flowing with its usual freedom, the part affected has not its proper supply of perfectly arterial blood. Hence congestion in the head must, even from this cause alone, produce drowsiness, to say nothing of the effect of pressure on the cerebral substance.

granted, it must be viewed, not as the cause, but as a circumstance, or, in fact, a consequence, of ordinary sleep. Increase the activity of an organ, you increase its circulation; diminish its activity, you diminish its circulation. The alteration of circulation is usually not the cause but the consequence; necessary, indeed, to the continuance of the altered degree of activity in the organ, but not the cause. The degree of activity of any part, and the degree of its circulation, are exactly and unalterably correspondent. If the circulation through a part be mechanically increased or diminished, the sensibility and activity of the part will, doubtless, be proportionally increased or diminished. This example occurs in hemorrhage. Frequently both are affected simultaneously, — when diarrhœa renders the surface pale and cold, both the blood is sent more sparingly to it, and the energy of its vessels is diminished by the increase of energy in those of the intestines. But, in ordinary sleep, the diminished circulation appears only the consequence, for activity is always followed by inactivity. Stimulate a muscle separated from the body, it contracts, but it soon refuses to do so; after a little rest, it again contracts upon the renewal of the stimulus. The case of the brain is analogous; and when, after its daily activity, it falls asleep, the diminution of its circulation consequently ensues. The influence of sleep upon the cerebral circulation is shown by the headach and other marks of congestion which follow too much sleep. Boerhaave mentions a student who took a fancy that sleep was the natural state of man, and so slept eighteen out of the twenty-four hours, till he died of apoplexy. The horizontal posture will not explain these ill effects, because persons with spinal disease will lie a year upon the back without them.

Sleep is an inactive state of the brain, resulting ordinarily from mere fatigue of the organ through its activity: though pressure, want of proper blood, narcotics, &c. or want of exciting causes, may prevent activity, and thus induce sleep.[u] The case

[u] The most silly discussions may be found in old authors and modern twaddlers (see, for instance, *Isis revelata*, a book soon to be quoted) about the state of the soul in sleep. "There have been great disputes," says Gall, "upon the question, whether the soul can ever exist, as in sleep, without feelings or ideas? If we lay aside all vain metaphysical subtlety, the answer is very easy. In this life the soul receives its feelings and ideas by means of cerebral organs; when these

of the brain is the same as that of voluntary muscles. If these are laid bare and freely stimulated, they at length cease to contract; after a little repose, they obey a stimulus again. The brain may be kept awake by strong exciting causes long after it would have sunk into inactivity; but at length no stimulus will rouse it and sleep is inevitable. Exhausted soldiers sometimes sleep as they march, or sink on the ground in deep slumber amidst the roar of cannon. Still more readily will the young. During the battle of the Nile some boys fell asleep on deck in the heat of that dreadful engagement.[v]

In sleep the function of the brain is suspended, and, if it is perfect, there is no sensation, consciousness, thought, emotion, or volition: but the degree of suspension is extremely various. In ordinary sleep the mind is susceptible of sensations, and able, if these are unpleasant, to make an effort to remove their causes; — whether to remove the uneasiness of impeded circulation in the lungs by breathing, or to draw away the hand when tickled, or change our position, as some continually do in sleep. One or more faculties is often active, and one idea associates with it another, intellectual or moral, so that we dream; but the activity of the mind is partial, and, though we are able occasionally even to reason correctly in our dreams, we are not sufficiently

organs are completely inactive, the soul can have neither feelings nor ideas. Deep and complete sleep is a temporary cessation of personality (*moi*)." (ll. cc. 4to. vol. ii. p. 454. 8vo. t. ii. p. 506. sq.) By soul Gall meant cerebral power: but he wrote cautiously, as in Austria, Italy, and France, catholics are not contented to base our hopes of a future life upon Scripture, but insist on the existence of a soul to make Scripture probable.

[v] Dr. Macnish.—Blumenbach and Cabanis call sleep a function. The former says, "Sleep is a completely periodical function, by which the intercourse of the mind and body is suspended, and whose phenomena correspond, if any do, with the supposition of a nervous fluid." To say intercourse of mind and body, and not activity of brain and its dependences,—the rest of the encephalo-spinal system, and to say nervous fluid, is antiquated nonsense. Cabanis's words are, "Sleep is not simply a passive state, but a peculiar function of the brain." The answer to both these writers is, that "the cessation of a function cannot be a function." How different is the language of Gall: "Sleep is merely in the activity, the perfect repose of the brain in health. During this suspension of the cerebral functions, the brain acquires new force, and, on waking, its functions take place readily." l. c. 8vo. t. i. p. 210.

ourselves to discover the incompatibility of many circumstances which we fancy. In a higher degree of activity, we answer questions put to us, although often ridiculously, as our deficiency of mental power prevents us from keeping our associations in a proper train; and we sometimes even perform a regular series of movements. Somnambulism is but imperfect and partial sleep. In it persons walk and even perform a variety of other actions, without hearing or seeing, or consciousness of their situation, so that they fall over things placed in their way, or down a descent. They will sometimes write excellent letters, compose good verses, and perform accurate calculations, in this state, and on being roused into consciousness know nothing of what has happened. This state generally occurs in sleep, but it occasionally seizes persons awake, and is then termed ecstasis.[w] This is by no means uncommon at the commencement or termination of epileptic or hysteric paroxysms. In an opposite morbid affection, the patient is conscious and sensible of every thing around, but unable to move, or give the least sign of life.[t]

Dreaming and mental activity of all degrees in sleep, from merely turning in bed, to talking, walking, and composing, are partial activity of the brain. "Almost all physiologists agree," says Gall, "that in dreaming animal life is partially active. They are right, and yet they deny the plurality of organs! But dreams cannot be conceived without the hypothesis of this plurality."

"When, in sleep, particular organs of animal life become active, the sentiments and ideas which depend upon them must necessarily be awakened; but, in this case, the activity is independent of the will.

"When one organ only is active, the dream is simple: the object of our love is embraced, harmonious music is heard, we fight our enemies, accordingly as one organ or another is performing its functions.

"The more organs are in activity at once, the more the action of the dream will be complicated or confused, and the more incongruous will these be.

[w] A remarkable example is given in the *Psychological Magazine* of a young lady thus taken for dead, and after the funeral hymns were sung, &c. discovered to be alive by a sweat breaking forth at the moment she found the lid of the coffin was about to be nailed down.

"When the organs are fatigued by the waking state and exertion, we usually do not dream during the first hours of sleep, at least unless the brain is very irritable. But, in proportion as the organs become refreshed, they are more disposed to enter into activity, whence towards the approach of rising, we dream more and with greater vivacity."

"How is it that in a dream certain faculties occasionally display more energy than in the waking state? What precautions do we not take to meditate profoundly on a subject. We prevent all external impressions, we put our hand before our eyes, we shut ourselves up, to concentrate all our attention on a single point. The same thing takes place in certain dreams. All the vital energy is concentrated on one organ, or upon a small number of organs, while others are in repose; so that the energy of the former becomes necessarily more energetic. The sentiments and ideas excited in a dream are, in some cases, completely disengaged from all external mixture. We therefore cannot be astonished if some, like Augustus La Fontaine, make admirable verses in their sleep, or like Alexander draw out the plan of a battle; if others, like Condillac, solve difficult problems; if on waking in the morning some, like Franklin, find a work completed which had been projected on going to bed; if in sleep the true relations of things are discovered, which in the tumult of sentiments and ideas had defied our sagacity."[x]

In ordinary dreaming, our conceptions of objects of sense

[x] ll. cc. 4to. vol ii. p. 454, sq. 8vo. t. ii. p. 506, sqq. Cabanis relates that Franklin had on several occasions been informed in his dreams of the issue of affairs in which he was engaged. His vigorous mind, otherwise free from prejudice, says Cabanis, could not quite secure him from a superstitious notion with respect to these premonitions. He did not take into consideration that his profound prudence and rare sagacity still characterised the operations of his brain during sleep. It is also related of Condillac that, while writing his *Cours d'Etudes*, he was frequently obliged to leave a chapter incomplete and go to bed, and that, on awaking, he found it, on more than one occasion, finished in his head. Voltaire assures us that, like La Fontaine, he many times in his sleep made verses which he remembered on waking. Tartini composed his *Devil's Sonata* in a dream, in which Satan appeared and challenged him to a competition on his own fiddle. Coleridge prefaces his poetical fragment called *Kubla Khan* with the following account of himself: — "In the summer of the year 1797, the author, then in ill health, had retired to a lonely farmhouse between Porlock and Linton, on the Exmoor confines of Somerset and Devonshire. In consequence of a slight indisposition, an anodyne had been prescribed, from the effects of which he fell asleep in his chair, at the moment

are always far stronger than when we are awake: we always conceive with an intensity equal to sensation, — an impossibility in the waking state, unless under extraordinary excitement. — In sleep-waking, the conceptions have been so strong that an archbishop of Bordeaux declares of a young man, whose case will soon be related, that, dreaming he had just emerged from a stream, he shivered, his teeth chattered, he begged for brandy, and, on receiving water instead, again asked for brandy, took a glass of strong liquor, felt refreshed, and without waking fell into a perfect sleep. In sleep, things are sometimes remembered and spoken of, which had been forgotten: and we sometimes dream of our previous dreams, forgotten perhaps in our waking state: if we have remembered them when awake as dreams, we may dream of them as dreams, and sometimes, without having awakened after a dream, we dream on, dreaming again that the first was really a dream.[y] — Another instance of increased

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that he was reading the following sentence, or words of the same substance, in Purchas's *Pilgrimage*: 'Here the Khan Kubla commanded a palace to be built, and a stately garden thereunto; and thus ten miles of fertile ground were enclosed with a wall.' The author continued for about three hours in a profound sleep, at least of the external senses, during which time he has the most vivid confidence that he could not have composed less than from two to three hundred lines; if that indeed can be called composition in which all the images rose up before him as things, with a parallel production of the correspondent expressions, without any sensation or consciousness of effort. On awaking he appeared to himself to have a distinct recollection of the whole, and taking his pen, ink, and paper, instantly and eagerly wrote down the lines that are here preserved. At this moment, he was unfortunately called out by a person on business from Porlock, and detained by him above an hour, and on his return to his room, found, to his no small surprise and mortification, that, though he still retained some vague and dim recollection of the general purport of the vision, yet, with the exception of some eight or ten scattered lines and images, all the rest had passed away like the images on the surface of a stream into which a stone had been cast, but, alas! without the after restoration of the latter."

"Henricus ab Heer mentions the case of a student at a German University, who having been very intent on the composition of some verses, which he could not complete to his satisfaction, rose in his sleep, and, opening his desk, sat down with great earnestness to renew his attempt. At length, having succeeded, he returned, went to bed, after reciting his composition aloud and setting his papers in order as before." (*Isis revelata*, vol. i. p. 310.) "See what Hollman has related of himself in this particular. *Pneumotolog. Psycholog. et Theol. Natur.* Gotting. 1770. 8vo. p. 196."

[y] Dr. Macnish, l. c. p. 87.

excitement in dreaming is the extreme rapidity of conception, so that a succession of events may be crowded into a dream which we are certain cannot have lasted more than a few moments — a rapidity which takes place in the waking state only under the strongest excitement, as in the fear of instant death "Persons recovered from drowning have mentioned," says Dr. Macnish, "that in the course of a single minute, almost every event of their life has been brought to their recollection."[z] Some dreams have been singularly prophetic, from the extreme intelligence of the dreaming brain: in other instances, as when the prevision has related to the individual's death, the strong impression on the mind may have worked the fulfilment of the prediction: in others there may have been mere coincidence, but the coincidence has been most extraordinary. The greater part, however, of dreaming prophecies are never fulfilled.

The impression from dreams sometimes continues for life, especially from the dreams of childhood, and sometimes its events are afterwards confounded with reality.[a] We always wake from a dream in the mood of our dream: and, on waking from a terrific dream, emotion and unconsciousness that all was a dream have continued for a short time so powerful, notwithstanding the perception of all objects of sense around, as to cause the individual to jump out of window or to commit murder; sometimes insanity has resulted, and sometimes, as from strong emotion in the waking state, the cure of some disease.[b]

It is an error to suppose that our dreams are a mere repetition of sentiments and ideas previously experienced. Man may invent in his sleep just as when awake: for the internal sources of our sentiments and ideas are the same, whether we are asleep or awake.[c]

Dreams are no doubt forgotten as well as remembered: and, what is curious, we not only sometimes forget our dreams till we dream again, when the same things are recognised, with or without our knowing that they had been dreamt. We may dream of things as having been dreamt before, when, on waking, we cannot remember the circumstance.

To suppose, with some, that sleep is always accompanied by

[z] l. c. p. 62. [a] Dr. Macnish, l. c. pp. 46. 102.

[b] *Phil. Trans.* vol. ix., for such a cure of dumbness.

[c] Gall, ll. cc. 4to. vol. ii. p. 454.; 8vo. t. ii. p. 506. sqq.

dreams, though not remembered by us[d], is a mere assumption and indeed very improbable; and it is the offspring of another assumption, — that we have souls, it being settled that souls are sleepless things.[e] Perfect sleep must be free from them; though slight dreaming stands on the same footing with coughing, and cannot be considered sufficient to constitute disease. Some always dream; some never.

In Locke we find the following passage: — "I once knew a man that was bred a scholar, and had no bad memory, who told me, he had never dreamed in his life till he had that fever he was then newly recovered of, which was about the five or six and twentieth year of his age. I suppose the world affords more such instances."[f] "For many years before his death, Dr. Reid had no consciousness of ever having dreamed."[g] The rev. Mr. Jesse, of Margaretta, in Essex, informs me that he knew a carpenter who never dreamt till after a fever in his fortieth year; and, as he before never could be made to understand what dreaming meant, so when he first dreamt he was as much surprised as perhaps Adam was when he first felt himself going to sleep. He was a man of a remarkably good, quiet, and plodding disposition.

We occasionally know a dream to be a dream and even act against it: as when Dr. Reid, finding himself subject to frightful dreams, determined to acquire the habit of remembering their

[d] "Consult Kant, *Critik der Urtheilskroft*, p. 298.; and *Anthropolog.*, p. 80."

[e] Locke reasons powerfully on this point: "'The soul, during sound sleep, thinks,' say these men." — "Methinks, every drowsy nod shakes this doctrine." — "Nature never makes excellent things for mean or no uses; and it is hardly to be conceived that our infinitely wise Creator should make so admirable a faculty as the power of thinking, that faculty which comes nearest the excellency of his own incomprehensible being, to be so idle and uselessly employed, at least a fourth part of its time here, as to think constantly, without remembering any of those thoughts, without doing any good to itself or others, or being any way useful to any other part of the creation. If we well examine it, we shall not find, I suppose, the motion of dull and senseless matter, any where in the universe, made so little use of, and so wholly thrown away." — "They, who make the soul a thinking being, at this rate, will not make it a much more noble being, than those do, whom they condemn, for allowing it to be nothing but the subtilest parts of matter." *Essay concerning Human Understanding*, b. ii. ch. 1. ss. 12, 13. 15.

[f] l. c. b. ii. ch. 1. s. 14.

[g] Dr. Macnish, l. c. p. 45.

dangers were imaginary, and always threw himself down a precipice near which he dreamt he was standing, and thus destroyed the illusion; or, as Dr. Beattie, when, dreaming himself in danger upon the parapet of a bridge, and reflecting he was not in the habit of such pranks and might therefore be dreaming, determined to awaken himself by pitching over, and did so with success.[h]

Dreams differ much in their absolute vividness, as well as in the impression they make and the degree in which they are remembered.

We sometimes wake in our dream, and soon fall asleep and experience a continuation of it.

I conceive that all the phenomena of dreaming resolve themselves into partial activity of brain, partial not in Gall's view only, who considers that there is activity of one or of a limited number of cerebral organs, but also partial in regard to individual organs, —one portion of an organ being active and another not; and I conceive that the activity of the organ or portion of organ or organs may be of various degrees of intensity. All the phenomena of dreaming may be thus explained: though some, strangely enough, cannot understand how to view dreaming as a disturbed state of *brain* is at all more explanatory than to view them independently of the brain; and call it "making insignificant speech supply the place of analysis," or, "merely a translation of one language to another,"[i] to take into consideration the organ, the disturbance of whose functions actually constitutes dreams.

An idea, being excited, excites another associated with it by the order of previous occurrence, by similarity, or some other of the endless modes of association, exactly as happens in the waking state. But, as our brain is imperfectly and partially active, so that we are not, as in the waking state, intelligent enough to perceive the grossest incongruities and impossibilities, nor possessed of power of volition sufficient to detain an idea and prevent its floating off and being replaced by another associated with it perhaps in the most trifling manner, and this by another and another in endless successive images, thoughts riot on in confusion, not in the order of previous succession, as some assert, but

[h] Dr. Macnish, l. c. p. 108. sq.

[i] *London Review*, No. II. p. 430. *Isis revelata*, vol. ii. p. 120.

more like the cross reading of a newspaper, according to a remark of Dr. Macnish.[k]

> "Fancy,—
> Wild work produces oft, but most in dreams,
> Ill matching words, and deeds long past or late."[l]

A dream sometimes continues rational and consistent till near its end, when it suddenly becomes absurd.[m]

Some have supposed that the diversity and incongruous character of dreams "arises solely from our having no external sensations."[n] This appears to me a very confined view of the state of the mind during dreaming. The want of external sensations is not the only point, nor the chief point; but the want of intelligence and volition, and the intensity of our conceptions. We may have sensations and yet be asleep and dream. We may feel heat applied to our feet and fancy we are in eternal torments: yet should we wake, without any further use of our external senses, without smelling, tasting, hearing, seeing, and without moving, we discover the unreality of our fancy, and, though we should be lying uncovered on the ground in the dark, with no means of knowing by external sense where we are, or how we got where we are, we know for certain that we not in hell, but are satisfied of being still upon earth. In truth we think the most acutely when we have no external sensation. When we wish to meditate, we seek silence, generally shut our eyes, and may become motionless so as to have no touch, and as to tasting and smelling we do not think of such things. We often meditate in bed in the darkness and stillness of night, and forget where we are. While excluding and not aware of any external sensations, we may be most successful in poetical conceptions, and yet do not mistake them for realities. The evident reason of which is the same as of our poetry differing from the wild nonsense of dreams:—we are awake and fully intelligent. Of course, when we are awake, our external senses are in play, give us information, and may correct our thoughts: but, if their impressions may have no relation to our thoughts, and thus afford no correction, and yet we can medidate most philosophically without dreaming, their activity generally cannot be the cause of our not being asleep and dream-

[k] l. c. p. 49.

[l] *Parad. Lost*, B. v.

[m] Hood's *Whims and Oddities*, quoted by Dr. Macnish, l. c. p. 42.

[n] Darwin, *Zoonomia*, vol.i. p. 293.

ing. The very want of external sense is the effect of the sleep of a portion of the brain: and the want of intelligence is another effect; not the effect of the want of external sense.

It is the same with the portion of the brain devoted to emotions, notwithstanding the ideas calculated to excite them are perhaps present. Few or more may be inactive. "Objects, scenes, and circumstances present themselves to the mind, unassociated with those feelings with which they are usually or invariably accompanied in our waking hours. Thus in our dreams we may walk on the brink of a precipice, or see ourselves doomed to immediate destruction by the weapon of a foe or the fury of a tempestuous sea, and yet feel not the slightest emotion of fear, though, during the perfect activity of the brain, we may be naturally disposed to the strong manifestation of this feeling; again, we may see the most extraordinary object or event without surprise, perform the most ruthless crime without compunction, and see what in our waking hours would cause us unmitigated grief, without the smallest feeling of sorrow. Dreams of this kind are more incoherent, and are subject to more rapid transitions than those in which one or more organs of the feelings are also in a state of activity."[o] We might as well ascribe want of emotion to the want of external sense.

Again, we sometimes have great emotion during sleep: sexual desire, terror, rage, &c.[p]; and we sometimes have great intelligence, of which instances have been already given. But the

[o] *Some Remarks on Dreaming, Somnambulism, and other States of partial Activity of the Cerebral Faculties.* Read to the London Phrenological Society, by Professor Wheatstone, and published in the *Lancet*, March 31. 1832, through misprint, as by Mr. Weisten; and Dr. Macnish quotes it as mine, with a compliment to the acuteness of the last sentence. (l. c. p. 76. sq.) But I am happy to say that there is at King's College, as well as at University College, a professor who has for many years been a decided phrenologist and avows his conviction. Excepting this original remark, the paper is professedly nothing more than a translation and illustration of Gall. I am indebted to it for my references to Coleridge, Tartini, and M. Giron de Buzareingues, not to Dr. Macnish, who appears to have taken them from it without acknowledgment, and after all is incorrect, as he puts Cabanis for Franklin, and Condorcet for Condillac.

[p] Porro hominum mentes magnis quæ motibus edunt?
Magna etiam sæpe in somnis faciuntque geruntque.
Reges expugnant, capiuntur, prælia miscent;
Tollunt clamores, quasi si jugulantur ibidem,
Multi depugnant, gemitusque doloribus edunt. *Lucretius.*

intelligence, however acute, is limited: concentrated in one point, without the general intelligence of our waking moments, so that a collateral incongruity or impossibility is not detected.

I believe that excitement of the portions of the brain destined for emotion is more frequently the cause of the train of ideas than those of the intellect; just as the hallucinations of madmen most frequently arise from the morbid state of a feeling, — the idea of being God or an Emperor, for instance, from inordinate pride: and I may mention that Prof. Wheatstone remarked to me in conversation that his observation of the greater incoherency and rapidity of transitions in dreaming, where emotion was not excited, might be extended to insanity. Still, I should say that, if very many passions are excited in either dreaming or insanity, this effect of emotion will be lost and the incoherence be very great. The organs of the feelings may be excited alone in sleep. We often wake under emotion, without knowing why. If it is urged that we may have dreamt unpleasant things, but forgotten them, which may be true, for we may recollect our dream after some lapse of time, I add that, after going to bed under distress of mind, we often wake in the morning feverish and wretched without knowing why, till, after trying to consider the reason, we in a few minutes recollect the real cause of our disquietude. The emotion or unpleasant excitement of an organ of a feeling must have existed during sleep, unaccompanied by images; at least their occurrence is a mere hypothesis.

The excitement may be limited even to portions of organs, or to particular modes of excitement. Just as in paralysis we sometimes find one patient's organ of language so affected that he forgets nouns substantive only, and but some of them, and another forgets one particular language only of two or more that he may have learnt, so in dreaming we may hear or talk one language only of several that we know, or we may see every thing of one colour.

The excitement of the individual part that dreams may of course be of all degrees: the conceptions may be almost too obscure for us to discern them: they may be most vivid: we may surpass our best efforts of the waking state, as happens sometimes in insanity: we may remember things forgotten, and which we have in vain attempted to remember; nay, we probably sometimes remember in our dreams without ever being aware that what we

dream is the result of memory, and thus have revelations which appear singular, but which are merely revived knowledge, utterly forgotten.[q] Dreaming being only excitement of some portion or portions of the brain while the rest are asleep, the causes of dreaming, no less than their mode of operation, must be analogous to those of excitement in any other organ. These exciting causes will produce their effect, like all other exciting causes, not only according to their own intensity, but according to the predisposition and present degree of excitement of the brain; having, unless powerful, no effect if the brain has no undue irritability or present excitement, and having, though feeble, great effect if the brain is very irritable or already much excited: and, where either of the latter circumstances exists, dreaming will occur without any adventitious cause of excitement. We may dream from an external impression upon any of our nerves or from feelings produced in any internal part: from light being let into the eyes, external heat or cold, titillation, an uncomfortable bed, motion, pain, uneasiness of the digestive organs, &c. We may dream from the brain being excited sympathetically with the condition of any other organ, just as all other organs may sympathise with each other: as the state of the kidney or the brain may produce vomiting, the state of the stomach produce headach, though productive of no uneasy sensation in the stomach itself, so the administration of substances possessed of the power of stimulating the brain in particular, as certain narcotics in doses not sufficient to overpower the organ and cause sleep, may induce dreams. Whatever excites the blood-vessels of the brain will do the same: the ingurgitation of stimulants, blows, great functional excitement, and any cause of an inflammatory state or an approach to it. When the brain is irritable by disease, as in fever, dreaming occurs; and, sleep taking place with difficulty, the delirium of approaching sleep continues so long and sleep is so often interrupted, that nurses tell us that the patient wandered greatly at night. But, independently of its excitement of such a state, the functional excitement of the brain in the waking state may be too great for complete sleep, by not easily subsiding, so that, if not too great to prevent sleep, it may continue sufficiently to prevent the

[q] See a curious instance of the discovery of legal papers by a dream, in Sir Walter Scott's notes to the *Antiquary*.

complete repose of the brain, and may cause dreaming. Like delirium, dreaming may arise from the opposite of stimulation,—from the want of due stimulation, as from want of food, or want of stimuli rendered necessary by habit. In dreaming there will be all degrees and extent of excitement, just beyond perfect repose or sound sleep, and just short of the waking state.

From the great irritability of children, shown by the facility with which they have convulsions and inflammation, they dream much; and their dreams are more frequently frightful than those of adults. Old people, from the lightness of their sleep, also dream much.

From the renewed power and irritability of the brain we dream much more as the period for waking approaches.[r]

The greater the development of a particular part of the brain, and the greater its natural or acquired irritability, the more liable will it than other parts of the brain be to dream; and for the same reason dreams partake of the individual's character, and, as old people remember the events of their early life the best, they dream most of these, while young persons dream of recent things.[s] There are however exceptions to this. The natural character of the insane generally continues in their disease, but sometimes is quite altered: and dreams may occur in which the tone of the feelings may differ from that of the waking state. The dreams of drunkenness and under the influence of narcotics are the most extravagant.[t]

A curious circumstance is the direction given to dreams by the character of the exciting cause. When they arise from uneasy sensations, they are disagreeable; and I may remark that, if the cause of dreams is disagreeable, all the feelings excited will be excited disagreeably, and the images will be disagreeable. Even a strange bed, though soft and warm, may make us dream simply because it is not that to which we have been accustomed. If there is any discomfort, mental or physical, sleep may be interrupted the moment after it has begun by a sudden, and perhaps violent, start, or by a sensation of a blow or push, or of a loud noise:

[r] Lord Brougham contends that we dream only during the "transition into and out of sleep." (l. c. p. 117.) This opinion is disproved by watching persons in sleep and observing them toss about and mutter, evidently dreaming, though their sleep continues.

[s] Dr. Macnish, l. c. p. 82.

[t] Ibid. l. c. p. 95.

and it may not be till after this has occurred more than once that the person settles into sleep. Some always experience this on first losing themselves, and then go to sleep for the night.[u] Aristides dreamt that a bull attacked him but only struck his knee; on waking a small boil was there. Dr. James Gregory, having applied a hot bottle to his feet on going to bed, dreamt that he was walking up Etna and finding the ground insufferably hot. One with a blister on his head, dreamt that he was being scalped by Indians. One in a damp bed, that he was being dragged through a stream. A gouty man, when beginning to feel his pain in his sleep, may dream he is on the rack before inquisitors. The sound of music may excite delightful dreams. M. Giron de Buzareingues made some curious experiments on this point, and directed at pleasure the character of his dreams. In his first experiment, having allowed the back of his head to be uncovered during sleep, he thought he was at a religious ceremony in the open air: the custom of the country in which he lived being to keep the head covered excepting on some rare occurrences, among which was the performance of religious ceremonies. On waking, he felt cold at the back of the neck, as he frequently had when present at the real ceremonies. He repeated the experiment in two days, with the same result. In a third experiment he left his knees uncovered, and dreamt that he was travelling at night in the diligence, and all travellers know, he observes, that it is chiefly at the knees they feel cold when travelling by that conveyance at night.[x]

When sleep has not been profound, and persons have muttered, I have amused myself with speaking to them and getting answers from them. Dr. Beattie mentions a man "in whom any kind of dream could be induced, if his friends, by gently addressing him, afforded the subject matter."[y]

[u] Dr. Macnish, l. c. p. 28.

[x] Dr. Magendie's *Journal de Physiologie*, t. viii.

[y] "*Dissertations Moral and Critical.* London, 1783. 4to. p. 217."

Though the nature of dreaming is evident, some writers are so little advanced as to be ignorant of it, and have no other than the most antiquated notions. Mr. Colquhoun, as we shall see, p. 691. *infrà*, supposes that, in dreaming, the soul is struggling to act without the body! and Lord Brougham, conceiving that the mind acts better the more "the influence of the body is withdrawn," says that dreams throw a strong light upon the "subject, and seem to demonstrate the possible disconnection of mind and matter," and illustrate "the mind's independence of

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The power of volition is exerted in two ways — in dwelling upon feelings or ideas, and in exciting muscular motion. (See *suprà*, p. 346. sq.) While we dwell upon a feeling or idea, association occurs, and the various faculties enable us to judge and invent; we remember, desire, &c., attending to some ideas and feelings, and neglecting others. In dreaming, our faculties judge, remember, invent, in general, very imperfectly; or, if on rare occasions, well, and even admirably, on a single matter, still many of our faculties are in total, partial, or a certain degree of repose, and as soon as our dream turns off to something else, absurdities

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matter and capacity of existence without it." (*A Discourse on Natural Theology*, p. 111.) It is very strange, however, that, when the soul is thus unfettered or half unfettered, and thinks by itself, it thinks so oddly, and works, in the vast majority of cases, so much worse than when it has the full assistance of the brain, that we are accustomed, if a man talks or writes nonsense, to say he is dreaming. Even the soul's consciousness of self often becomes false in dreams; and we feel ourselves "conscious of being, or having been, parties in acting and suffering what not only never did, but never could, take place:" "indeed any dream is more or less, may I not say considerably, a check upon the mind of the waking man," and "when we are taxing recollection for by-gone events, we frequently exclaim, 'Did I really do so and so, or did I only dream it.'" (*Observations on the Discourse of Natural Theology*, by Thomas Wallace, Esq. LL.D. p. 107.)

Locke, who argued well for us materialists, says, "How extravagant and incoherent for the most part they are; how little conformable to the perfection and order of a rational being, those who are acquainted with dreams need not be told. This I would willingly be satisfied in, whether the soul when it thinks thus apart, and as it were separate from the body, acts less rationally than when conjointly with it, or no. If its separate thoughts be less rational, then these men must say, that the soul owes its perfection of rational thinking to the body; if it does not, it is wonder that our dreams should be for the most part so frivolous and irrational; and that the soul should retain none of its more rational soliloquies and meditations." (l. c. b. ii. ch. i. s. 16.)

Democritus and Lucretius account for dreams by fancying that the forms or spectres of corporeal things, constantly emitted from them and floating about, assault the soul in sleep: and Baxter, by fancying that spiritual beings amuse or seriously busy themselves in making our souls active in sleep: and I think they had as much reason on their side as Lord Brougham and Mr. Colquhoun.

commence: nay, coherency, after continuing a long while, often terminates in an absurdity on the same subject. The power of volition, whether over our feelings and ideas or muscles, in sound sleep can be but moderately exerted; but its diminution has endless degrees.[z] We may have little or no command over our thoughts, or we may have much, as when we reason, calculate, or compose well. We have all shades of amount of power over our muscles: we breathe, cough, move our head, limbs, and even our trunk, more or less, in ordinary sleep; people forcibly roused frequently get out of bed and begin dressing before they know where they are or what they are about; and, when overcome with sleep in the midst of forced exertion, will continue standing or walking or even moving their fingers at their work. Sometimes we will, in vain, as when awake. When awake, we often make great efforts in vain to detain particular ideas and understand or produce, but find we cannot fix our attention to the point, or, if we do, that our cerebral organs are incapable of work; sometimes we will motion without effect. So in sleep, not only is our will generally feeble, but sometimes strong yet unobeyed. We strive in vain to detain thoughts, or, if we succeed, still certain faculties prove powerless. We may will much exertion strenuously, but the part of the nervous system connected with the central extremities of the voluntary nerves is incapable of being stimulated by that which is endowed with mental power. In that imperfect sleep called night-mare, we will violently in vain, but cannot move a muscle, nor utter a cry. Persons believe that, if they can but move or even cry out, they shall recover themselves, mistaking effect for cause: they move and cry out the moment they have recovered.

The phenomena of partial sleep are seen more remarkably in the state called somnambulism, or sleep-walking, than in common dreaming. The term sleep-waking, or somno-vigilium, has been proposed, and is very appropriate, because in this state patients may not walk, or may even be unable to walk. The individual is capable of no impression from his external senses, or from one or some of them only, and, if capable, either perfectly or in

[z] Dr. Darwin (*Zoonomia*, vol. i. sect. 18. p. 286.), and after him Prof. Dugald Stewart, contended that, in sleep, volition was suspended. Dr. T. Brown refuted them in his *Observations on the Zoonomia*.

various degrees of imperfection; some of his intellectual faculties are highly active, and this in various degrees, while others are in complete torpidity; and the various inclinations and emotions may be all inactive or one or more active in various degrees: volition may be exerted over the muscles so that the person shall talk, or walk, and execute various movements, or shall dwell upon ideas at pleasure, and reason and compose, without any general intelligence, so as to be in reality still asleep. Just as occasionally in insanity and in ordinary dreams, an intellectual faculty is sometimes heightened; and sometimes muscular strength, or more properly the force of volition over the muscles. Generally the whole is forgotten: sometimes remembered; sometimes remembered and mistaken for reality; and sometimes remembered only when the same state returns. When persons use their muscles, there must be that internal feeling which accompanies all muscular exertion (p. 527.), — there must be the feeling of weight and resistance. I saw the sleep-waking condition strikingly exhibited lately in a patient of mine in University College Hospital, — a girl, sixteen years of age, destitute of the sense of smell as long as she could remember, subject to pain of her vertex, and, like a sister, epileptic, though very intelligent, very facetious, and of excellent behaviour. After the Baron Dupotet, passing the ends of his fingers up and down before her, had sent her to sleep, on many occasions, for a few minutes at a time, she was observed one day suddenly to talk unconnectedly and move her arms and hands about, though incapable of hearing, seeing, or feeling. She lay in bed or sat, with her eyes open, saying a great number of things, such as she might say when awake, told stories, and with great expression of voice, features, and manner, mimicked the voices and conversation of many fellow-patients accurately, and mimicked the manipulations of Baron Dupotet; yet she saw nobody, could not be roused by hallooing in her ear, and bore the sharpest pinches with indifference. She was cross, expressed displeasure at having before been magnetised, said she would not be made a fool of, complained of different things, shook her head, moving it forwards and frowning, and saying, "You dirty beast." Her hands were very cold in such attacks, and her whole surface pale. She would suddenly come out of this state, stare about like a person waking, rub her eyes, become still, smile, and be completely herself without

the least knowledge of what she had been doing, and feel quite ashamed and beg pardon, when informed that she had said we made a fool of her. After some hours, or days, the attack would return. But, before she remained permanently awake, shesome times fell back repeatedly into the sleep-waking: and nothing could be more striking than to see her eyes suddenly fixed unconsciously, and then all the phenomena of perfect external insensibility and talking begin again in less than a minute: and, in a few minutes, to observe her become suddenly still, look wild or fall fast asleep for an instant, rub her eyes, be sentient of every thing around her, smile, and in short in less than a minute be wide awake, without any knowledge of the state in which she had just been. As she could not be awakened by the strongest agency applied to her external senses, I resolved to try the effect of producing an internal sensation, and heightening her volition over her voluntary muscles. I took her off the bed, and found she could not stand. Two of us supported her erect, and lessened the support now and then, so that she might feel she was falling. Her knees bent, and she would have fallen, had we not held her up. This was repeated a few times, till at last she seemed to feel the ground a little with her feet, and, when we lessened our support, her knees bent less: at length she stood pretty well. Then I forced her on, and, though her legs at first dragged, she at last feebly attempted stepping, soon she walked, and, when she walked firmly, being led on quickly by one of us on each side, she suddenly awoke. This was all the work of not five minutes. I presently laid her down on the bed, and she in a minute relapsed into her old condition: I raised and walked her again, and she was instantly restored; and remained without any return for a week. I did not afterwards succeed in this way. When the affection returned it was not so marked. She had some power of perceiving persons, and hearing and feeling, so that she gave a certain amount of answer and expressed some uneasiness on being pinched. After a few days such attacks ceased, but she fell into the delirium only of the state, — ecstatic delirium: having the full use of her external senses, her volition over her muscles, knowing where she was, and active in all her intellectual faculties and feelings, saying she felt as if her brain was coming out and was too big for her head, and begging me to cut her head off; in short, being wide awake, but wandering unconnectedly from one subject

to another, dejected, saying innocent, but absurd, rude, though often witty and droll, things, which showed her feelings to be disturbed, incoherent, and mimicking admirably, whistling and singing well; and picking paper or linen to pieces: at length in her attacks she occasionally swore, and was amorous. After remaining in this condition for a few days, she suddenly by mesmeric manipulations one evening became herself completely; still complaining of pain at the top of her head, which she had suffered from for many months and for which I had bled her repeatedly. She afterwards suddenly fell into this delirium again several times, and, after continuing in it some hours or days, would by mesmeric manipulations in two or three seconds become completely herself and remain so for some hours or days. To observe her picking paper or linen to pieces, talking incoherently, now whistling aloud, now singing in the ward, cross, miserable, rude, dancing about, unable to look steadily for many seconds, her eyes converging from parallelism, her countenance pale, and expressive now of insanity, now of fatuity; and then in two or three seconds to see her completely herself, smiling, perfectly rational, amiable, well behaved, with an expression of great intelligence, was one of the most extraordinary changes I ever witnessed; — to see the functions of the brain in many points nearly suspended, in many over excited, and in many wrong, — the organ altogether oppressed and deranged, and then righting itself and performing all its functions properly in an instant, made an impression upon me never to be effaced. When not in an attack, she forgot every thing that had occurred in her attacks: but, when in them, she recollected the occurrences of preceding attacks. In the delirium her hands were not always cold as in the sleep-waking. The pulse appeared hardly affected.

I will relate a number of examples of sleep-waking to show the various amount and extent of activity in this condition.

This first is very similar to that of my own patient, but *sleep-walking* was added in one stage of the paroxysm.

" At Berlin," says Gall, " a young man, sixteen years old, had extraordinary attacks from time to time. He was agitated in his bed without consciousness; his movements and gestures showed a great activity of many internal organs; whatever was done to him, he did not perceive it; at length he jumped out of bed, and walked hastily in the apartment: his eyes were then

fixed and open. I placed different obstacles in his way, which he removed with his hand, or carefully avoided; then he threw himself suddenly on his bed, was agitated there some time, and at length awoke and sat up, very much astonished at the number of curious persons who were about him."

Here was a certain amount of *sight* and *touch*, and *sense of resistance and weight*; all was *forgotten*; the changes were *sudden*.

"M. Joseph de Roggenbach, at Friburg in Brisgau," continues Gall, "told me, in the presence of many witnesses, that he had been a somnambulist from his infancy. In this state his tutor had frequently made him read; made him look for places on the map, and he found them more readily than when awake; his eyes were always open and fixed; he did not move them, but turned his whole head. Many times they held him, but he felt the restraint, endeavoured to liberate himself, but did not wake. Sometimes he said he should wake if they led him into the garden, and *this always happened*."

Here was a certain amount of *sight*, *touch*, and feeling of *resistance* and *weight*; an *increase of one mental power*; and a certain *power of prediction*; he moved, not his eyes, but his *whole head*.

"I knew also the history of a miller, who, dreaming and with his eyes open, would go into his mill, enter upon his usual daily occupation, return to bed by the side of his wife, without remembering in the morning any thing he had done in the night."[a]

Here was a certain degree of *sight*, and feeling of *resistance* and *weight*; and all was *forgotten*.

M. Martinet speaks of a saddler accustomed to rise in his sleep and work at his trade[b]: and Professor Upham of an American farmer who rose in his sleep, went to his barn, and threshed out five bushels of rye in the dark, separating the grain from the straw with great exactness.[c]

These are examples of sleep-walking.

The following are examples of sleep-talking, or sleep-talking and sleep-walking:—

"Dr. Blacklock, the blind poet, on one occasion rose from his bed, to which he had retired at an early hour, came into the room where his family were assembled, conversed with them, and

[a] ll. cc. 4to. vol. ii. p. 456. sqq.; 8vo. t. ii. p. 510. sqq.

[b] *Bibliothèque Médicale.*

[c] *Isis revelata*, vol. i. p. 313. sq.

afterwards entertained them with a pleasant song, without any of them suspecting he was asleep, and without his retaining after he awoke, the least recollection of what he had done."

"Dr. Haycock, Professor of Medicine at Oxford, would deliver a good sermon in his sleep; nor could all the pinching and pulling of his friends prevent him." [d]

Horstius mentions a young nobleman who was observed by his brother to rise in his sleep, put on his cloak, open the casement, mount by a pulley to the roof of the citadel of Brenstein where he was, tear a magpie's nest to pieces, wrap the young ones up in his cloak, return to his room, place the cloak with the birds in it near him, and go to bed. In the morning he told the adventure as a dream, and was astonished when shown the magpies in his cloak, and led to the roof and shown the remains of the nest.

"An American lady, now, we believe, alive, preached during her sleep, performing regularly every part of the Presbyterian service, from the psalm to the blessing. This lady was the daughter of respectable and even wealthy parents: she fell into bad health, and under its influence, she disturbed and amazed her family by her nocturnal eloquence. Her unhappy parents, though at first surprised, and perhaps flattered by the exhibition in their family of so extraordinary a gift, were at last convinced that it was the result of disease; and, in the expectation that their daughter might derive benefit from change of scene, as well as from medical skill, they made a tour with her of some length, and visited New York and some other of the great cities of the Union. We know individuals who have heard her preach during the night in steam boats; and it was customary, at tea parties in New York (in the houses of medical practitioners), to put the lady into bed in a room adjacent to the drawing-room, in order that the dilettanti might witness so extraordinary a phenomenon. We have been told by ear-witnesses that her sermons, though they had the appearance of connected discourses, consisted chiefly of texts of Scripture strung together. It is strongly impressed upon our memory that some of her sermons were published in America." [e]

"A lady subject to spectral illusions would not only talk in

[d] Dr. Macnish, l. c. 182.

[e] *Fraser's Magazine.*

her sleep with great fluency, and repeat great portions of poetry, especially when unwell, but even cap verses for half an hour at a time, never failing to quote lines beginning with the final letter of the preceding, till her memory was exhausted." [f]

I will now give instances of sleep-floating and sleep-swimming.

Dr. Franklin says, " I went out to bathe in Martin's salt water hot bath, in Southampton, and, floating on my back, fell asleep, and slept nearly an hour, by my watch, without sinking or turning, — a thing I never did before, and should hardly have thought possible." This showed only the completeness of his repose: but Dr. Macnish quotes a case of actual swimming in sleep on the coast of Ireland. " About two o'clock in the morning, the watchmen on the revenue quay were much surprised at descrying a man disporting himself in the water, about 100 yards from the shore. Information having been given to the revenue boat's crew, they pushed off, and succeeded in picking him up, but strange to say, he had no idea of his perilous situation, and it was with the utmost difficulty they could persuade him he was not still in bed. But the most singular part of this novel adventure, and which was afterwards ascertained, was that the man had left his house at twelve o'clock that night, and walked through a difficult and, to him, dangerous road, a distance of nearly two miles, and had actually swum one mile and a half, when he was fortunately discovered and picked up." He then adds a case of fishing. " Not very long ago a boy was seen fishing off Brest up to the middle in water. On coming up to him, he was found to be fast asleep."

The information given us with respect to these cases extends no further, and we cannot tell the state of the eyes.

Dr. Pritchard mentions an individual who, having " been in the habit of frequenting a public promenade where he used to meet his acquaintances, was seen to rise from his bed at night and walk in his shirt along the same path, which extended a mile on the brow of a hill, stopping very frequently and greeting different individuals whom he had been accustomed to see in the same place." [g]

[f] *Edinburgh Journal of Science.* See Dr. Macnish.

[g] *A Treatise on Insanity and other Disorders respecting the Mind.* By James Cowles Pritchard, M.D. F.R.S. 1835. p. 407.

Vision might here have existed sufficiently to show him his way, though the state of his brain suggested to him imaginary forms; or he might have made his greetings by habit, without fancying he saw individuals.

"A female servant in the town of Chelmsford, surprised the family at four o'clock one morning, by walking down a flight of stairs in her sleep, and rapping at the bed-room door of her master, who inquired what she wanted; when, in her usual tone of voice, she requested some cotton, saying that she had torn her gown, but hoped that her mistress would forgive her: at the same time bursting into tears. Her fellow servant, with whom she had been conversing for some time, observed her get out of bed, and quickly followed her, but not before she had related this pitiful story. She then returned to her room, and, a light having been procured, she was found groping to find her cotton box. Another person went to her, when, perceiving a difference in the voice, she called out, 'That is a different voice — that is my mistress;' which was not the case, — thus clearly showing that she did not see the object before her, although her eyes were wide open. Upon inquiry as to what was the matter, she only said that she wanted some cotton, but that her fellow servant had been to her master and mistress making a fuss about it. It was now thought prudent that she should be allowed to remain quiet for some short time, and she was persuaded to lie down with her fellow servant that she might then awake in her accustomed manner. This failing in effect, her mistress went up to her room, and rather angrily desired her to get up and go to her work, as it was now six o'clock: this she refused, telling her mistress that if she did not please her she might look out for another servant, at the same time saying she would not rise at two o'clock, pointing to the window, to injure her health for any one. For the sake of the joke, she was told to pack up her things, and start off immediately, but to this she made no reply. She rebuked her fellow servant for not remaining longer in bed, and shortly after this became quiet. She was afterwards shaken violently, and awoke. She then rose, and seeing the cotton box disturbed, demanded to know why it had been meddled with, not knowing that she alone was the cause of it. In the course of the day several questions were put to her in order to try her recollection, but the real fact of her walking was not

made known to her; and she is still quite unconscious of what has transpired." [h]

Here sight was suspended, but *hearing perfect*, as well as *touch* and the *feeling of weight and resistance;* all was *forgotten;* she was *roused* by shaking, and with *impunity*.

A lad named George David, sixteen years old, in the service of Mr. Hewson, a "butcher in Bridge Road, Lambeth, at about twenty minutes past nine, bent forward in his chair, and rested his forehead on his hands, and in ten minutes started up, went for his whip, put on one spur, and went thence into the stable; not finding his own saddle in the proper place, he returned to the house and asked for it. Being asked what he wanted with it, he replied, to go his rounds. He returned to the stable, got on the horse without the saddle, and was proceeding to leave the stable: it was with much difficulty and force that Mr. Hewson, junior, assisted by the other lad, could remove him from the horse: his strength was great, and it was with difficulty that he was brought in doors."—"The lad considered himself as stopped at the turnpike gate, and took sixpence out of his pocket to be changed; and holding out his hand for the change, the sixpence was returned to him. He immediately observed, 'None of your nonsense, that is the sixpence again; give me my change.' When twopence halfpenny was given to him, he counted it over, and said, 'None of your gammon, that is not right; I want a penny more,' making the threepence halfpenny, which was the proper change. He then said, 'Give me my castor,' (meaning his hat) which slang term he had been in the habit of using, and then began to whip and spur to get his horse on. His pulse was at this time at 136, full and hard; no change of countenance could be observed, nor any spasmodic affection of the muscles, the eyes remaining close the whole of the time."—"During the time of bleeding, Mr. Hewson related a circumstance of a Mr. Harris, optician in Holborn, whose son, some years since, walked out on the parapet of the house in his sleep. The boy joined the conversation, and observed, 'He lived at the corner of Brownlow Street.' After the arm was tied up he unlaced one boot, and said he would go to bed. In three minutes from this time, he awoke, got up, and

[h] Dr. Macnish, 164. sqq.

asked what was the matter (having been then one hour in the trance), not having the slightest recollection of any thing that had passed, and wondered at his arm being tied up, and at the blood, &c."[i]

Here *sight*, *hearing*, and *touch*, as well as the sense of *weight* and *resistance*, were active; and all was *forgotten*.

According to the newspapers, a year or two ago, John Green, a plasterer, accused Mary Spencer at the Town Hall, Southwark, before Alderman Thorp, of stealing from him a pair of trowsers which he was carrying home at ten o'clock at night, through High Street, in the Borough, fast asleep.

"He deposed that, after finishing his work, he went to see some friends at Pimlico, and was accosted by a female; he had at the time a bundle under his arm. He knew no more of what transpired until between one and two o'clock on Sunday morning.

"*Alderman Thorp.* What! were you so drunk that you cannot tell what happened?

"*John Green* (with great simplicity). I was not drunk, your worship; I was fast asleep. (Laughter.)

"*Alderman Thorp*" (with greater simplicity, though officially one of those who are presumed competent to determine who are the fittest persons to be physicians and surgeons and teachers in St. Thomas's and other hospitals, and who generally allow themselves to be led by one whom they have made treasurer and consider fit to guide them in their judgment, having himself in most instances already retired from business). "You cannot be serious. I never heard of such a thing, as a man walking through a crowded thoroughfare, like the Borough High Street, without being disturbed.

"*John Green.* What I have stated, your worship, is true; I am unfortunately too frequently afflicted with fits of somnambulism; and, for greater security from robbers, I always make what articles I carry fast to my arm, so that if any one attempt to snatch it from me it would awaken me.

"*Alderman Thorp.* But how do you know the prisoner is the party who accosted you in the Borough? If you were asleep, you could not see her.

[i] *Lancet*, vol. i.

"*John Green.* Strange as it may appear, although I have not the power to arouse myself when in such a state of excessive lethargy, yet I can retain the sound of persons' voices in my mind, and, from the voice of the prisoner, I have not the least doubt she is the party.

"*Alderman Thorp.* How do you account for the lapse of time, from being accosted by the prisoner up to the time you discovered your loss?

"*John Green.* I am in the habit of walking for hours in my sleep, and if an attempt had been made to forcibly take the bundle from my arm, it would have aroused me; my handkerchief was cut, and thus the bundle was easily taken away.

"*Alderman Thorp.* I never heard such a case before; was the bundle found?

"Acting Inspector M'Craw, division M., answered in the affirmative, and added, that what the complainant had stated about walking the streets and roads was true: he had made inquiries, and found it to be the fact: it was well known to the police.

"Watt, Police constable 163., division M., deposed, that the complainant came to the station-house between one and two o'clock on Sunday morning, and made precisely the same statement he had made before the Alderman. The Inspector thought the tale savoured of the marvellous, and told witness to accompany him (complainant) in search of the property; and on arriving at a house in Kent Street, Borough, he said he thought the bundle was there. He knocked at the door, which was opened, and by the door of a room wherein the prisoner was sleeping, the property was found. The moment she spoke, he said the prisoner was the person who stopped him in the Borough. Witness took the prisoner to the station-house.

"The prosecutor here pointed out the way in which the bundle must have been taken away, and showed the Alderman the rent handkerchief.

"Mr. Edwards for the prisoner contended that no jury would convict upon the evidence of a sleep-walker, in prosecution against a street-walker. The prisoner laid no claim to the bundle; and as the complainant had sworn it was his property, the police would give it up to him.

"*Alderman Thorp* said it was so strange a case that he hardly

knew how to act; he should, however, under the doubtful circumstance as to identity, give the prisoner the benefit of it, and discharge her. The bundle was given up to the complainant.

"A gentleman, who was in attendance, said he had known the complainant many years, and it was not an uncommon thing for him to be seized with that unhappy affliction while at work on the scaffold, and yet he had never met with an accident, and while in that state, would answer questions put to him as though he was awake." [k]

Hearing was retained, as well as the sense of *weight* and *resistance*, and possibly *sight* to a certain degree; the attack came on suddenly, in the waking state; so that the case, like that of my patient, was one of partial sleep in the waking state,—ecstacy as it is termed, and not of partial excitement during sleep.

An Italian nobleman, named Augustin Forari, was subject to sleep-waking, and on one occasion watched by a Signor Vigneul Marville, who gave the following account:—

"One evening towards the end of October, we played at various games after dinner: Signor Augustin took a part in them along with the rest of the company and afterwards retired to repose. At eleven o'clock his servant told us that his master would walk that night, and that we might go and watch him. I examined him some time after with a candle in my hand; he was lying upon his back, and sleeping with open, staring, eyes. We were told that this was a sure sign that he would walk in his sleep. I felt his hands and found them extremely cold, and his pulse beat so slowly that his blood appeared not to circulate. We played at backgammon until the spectacle began. It was about midnight, when Signor Augustin drew aside the bed-curtains with violence, arose, and put on his clothes. I went up to him and held the light under his eyes. He took no notice of it, although his eyes were open and staring. Before he put on his hat, he fastened on his sword-belt, which hung on the bed-post: the sword had been removed. He then went in and out of several rooms, approached the fire, warmed himself in an arm-chair, and went thence into a closet where was his wardrobe. He sought something in it, put all the things into disorder, and having set them right again, locked the door, and put the key

[k] *Isis revelata.*

into his pocket. He went to the door of the chamber, opened it, and stepped out on the staircase. When he came below, one of us made a noise by accident: he appeared frightened, and hastened his steps. His servant desired us to move softly, and not to speak, or he would become out of his mind; and sometimes he ran as if he were pursued, if the least noise was made by those standing around him. He went into a large court and to the stable, stroked his horse, bridled it, and looked for the saddle to put on it. As he did not find it in the accustomed place, he appeared confused. He then mounted his horse and galloped to the house door. He found this shut; dismounted, and knocked several times at the door with a stone which he had picked up. After many unsuccessful efforts he remounted, and led his horse to the watering place, which was at the other end of the court, let it drink, tied it to a post, and went quietly to the house. Upon hearing a noise which the servants made in the kitchen, he listened attentively, went to the door, and held his ear to the keyhole. After some time he went to the other side, and into a parlour in which was a billiard table. He walked round it several times, and acted the motions of a player. He then went to a harpsichord on which he was accustomed to practise, and played a few irregular airs. After having moved about for two hours, he went to his room, and threw himself on his bed in his clothes, and we found him in them the next morning, for after his attacks, he always slept eight or ten hours. The servants declared they could put an end to the paroxysm only either by tickling his soles, or blowing a trumpet in his ear."[1]

Here, *hearing*, *touch*, the sense of *weight* and *resistance* were active, and probably *sight* to some degree; he was *roused* with *impunity*.

Drs. Righellini and Pigatti describe, from their own observation, the sleep-waking of a man servant named Negretti, twenty-four years of age, who, from his eleventh year, had experienced attacks of the disease in March, not extending beyond April. March 16. 1740, after going to sleep on a bench in the kitchen, he first began to talk, then walked about, went to the dining-room and spread a table for dinner, and placed him-

[1] L. A. Muratori, *della forza della Fantasia Umana*. Venezia. 1766. Dr. Pritchard, l. c.

self behind a chair with a plate in his hand, as if waiting on his master, the Marquis Luigi Sale. After waiting till he thought his master had dined, he cleared away, and put all the things into a basket, which he locked up in a cupboard. He afterwards warmed a bed, locked up the house, and prepared for rest. Being then awakened, and asked if he remembered what he had been doing, he answered, 'No.' Often, however, he did remember. On the 18th of the same month, he went through the same process, but, instead of going to bed, went into the kitchen and sat down to supper. Dr. Righellini, with many others, were very curious to see him eat. At once recollecting himself, the man said, 'How can I so forget? to-day is Friday, and I must not dine.' He then locked up every thing and went to bed. If water was thrown in his face or his eyes were forcibly opened, he would awake, but remained some time faint and stupid. His eyes were firmly closed in the paroxysm, and he took no notice of a candle placed close to them. Sometimes he went against the wall, and even hurt himself severely. If any body pushed him, he got out of the way, and moved his arms rapidly on every side: and, if in a place with which he was not well acquainted, he felt all the objects around with his hand, and showed much inaccuracy; but, in places familiar to him, he was not confused and went through his business well. After Dr. Pigatti had shut a door through which he had just passed, he struck himself against it on returning. Sometimes he carried a candle about, but, on a bottle being substituted, he carried it about as if it were a candle. Dr. Pigatti was certain he could not see. Once in his sleep he said he must go and hold a light to his master in his coach. Dr. Righellini followed him closely, and found that he stood at all the corners of the streets with his torch not lighted, waiting a while in order that the coach which he fancied was following might pass when the light was required. On one occasion he ate several cakes and some salad for which he had just asked the cook. He then went with a lighted candle into the cellar and drew wine, which he drank. He would carry a tray with wine-glasses and knives, and turn it obliquely, to avoid an accident, on passing through a narrow doorway. Dr. Pigatti once substituted some strongly seasoned cabbage for a salad which he had prepared and had sit down to eat: he ate the cabbage, and then some pudding which was substituted for it, without

perceiving the difference. At another time, having asked for wine, he drank water which was given to him; and sniffed ground coffee after asking for snuff. [m]

The state of *taste* and *smell* was here inquired into, and found inactive: *touch* and the sense of *weight* and *resistance* were active; *sight* inactive; and the actions were habitual.

Dr. Francesco Soave relates the case of Castelli, the pupil of an Italian apothecary. The youth was found asleep one night, translating Italian into French, and looking out the words in a dictionary. They put out his candle, when he, finding himself in the dark, began to grope for it, and went to light it at the kitchen fire, though other candles were alight in the room At other times he had gone down to the shop and weighed out medicines, and talked to supposed customers. "When any one conversed with him on a subject on which his mind was bent, he gave rational answers. He had been reading Macquer's Chemistry, and somebody altered his marks. This puzzled him; and he said, 'Bel piacere di togliermi i segni.' He found his place and read aloud, but his voice growing fainter, his master told him to raise it, which he did. Yet he perceived none of the persons standing round him; and though he heard," says Dr. Soave, "any conversation which was in conformity with the train of his ideas, he heard nothing of the discourse which these persons held on other subjects. His eyes seemed to be very sensible to objects relating to his thoughts, but appeared to have no life in them; and so fixed were they, that, when he read, he was observed not to move his eyes but (like M. Roggenbach, p. 631. *suprà*) his whole head from one side of the page to the other." [n]

Here was most decided *sight*, though the existence of it was so partial, and his mind could attend in so limited a way that the presence of other candles was not noticed, and he went to the kitchen for a light: *hearing* was active; of course the sense of *weight* and *resistance*, and *touch*. *Volition over the muscles* was rather weak, as his voice grew fainter while he read, and he did not exert the muscles of his eyes, but *moved his whole head*.

Still more, however, has been done in sleep-waking.

[m] Muratori, l. c.

[n] *Riflessioni sopra il Somnambolismo:* di Francesco Soave.

"In 1686, Lord Culpepper's brother was indicted at the Old Bailey for shooting one of the guards and his horse. He pleaded somnambulism, and was acquitted, on producing ample evidence of the extraordinary things he did in his sleep. There is a somewhat similar story of a French gentleman, who rose in his sleep, crossed the Seine, fought a duel, and killed his antagonist, without recollecting any of the circumstances when awake." [o]

The next, as well as the cases mentioned at p. 633. illustrates the occasional great acuteness of sleep-wakers. "A young man named Johns, who works at Cardrew, near Redruth, being asleep in the sumpter-house of that mine, was observed by two boys to rise and walk to the door, against which he leaned: shortly after, quitting this position, he walked to the engine shaft, and safely descended to the depth of twenty fathoms, where he was found by his comrades soon after, with his back resting on the ladder. They called to him to apprise him of the perilous situation in which he was, but he did not hear them, and they were obliged to shake him roughly till he awoke, when he appeared totally at a loss to account for his being so situated." [p]

In the following cases a partial increase of mental power took place, as is sometimes noticed in insanity and common dreams:—

"A story is told of a boy who dreamed that he got out of bed, and ascended to the summit of an enormous rock, where he found an eagle's nest, which he brought away with him and placed under his bed. Now the whole of these events actually took place; and what he conceived, on awaking, to be a mere vision, was found to have had an actual existence, by the nest being found in the precise spot where he imagined he had put it, and by the evidence of spectators who beheld his perilous adventure. The precipice which he ascended was of a nature that must have baffled the most expert mountaineer, and such, as at other times he could not have scaled." [q]

Gassendi tells of a man who often rose and dressed in his sleep, went into a cellar and drew wine, appearing to see in the dark as well as in the day; but, when he awoke either in the cellar or street, was obliged to grope his way back to bed. He often thought there was not light enough, and that he had risen

[o] *Isis revelata*, vol. i. p. 316.

[p] Dr. Macnish, p. 166.

[q] Dr. Macnish, l. c. p. 170.

too early, and therefore struck a light. He tells of another who passed on stilts "over a torrent asleep one night, and on awaking was afraid to return before daylight, and before the water had subsided." [r]

The intellectual achievements of Coleridge and others during ordinary dreaming are as striking as any thing of the kind to my knowledge recorded of sleep-waking.

An increase of muscular strength has sometimes, as in insanity, been noticed. One Sunday, Mr. Dubrie, a musician at Bath, attempted in vain to open a window that happened to be nailed down in his bed-room. At night he rose in his sleep, and made the attempt successfully, but threw himself out and broke his leg. [s]

The increase of mental power, in respect of determinate muscular movement, is shown in that unusual variety of chorea called leaping ague, in fits of which persons wide awake involuntarily dance admirably who had never learnt, performing the most difficult steps and exhibiting exquisite grace, rapidly execute all kinds of difficult movements, and run violently in the most dangerous situations without mischief. [t] Lord Monboddo describes a sleep-walking girl in Scotland, about sixteen years of age, who, in her fits, which began with drowsiness ending "in sleep, or what had the appearance of sleep, for her eyes were close shut," would leap upon stools and tables with surprising agility, and "run with great violence and much faster than she could do when well, but always with a certain destination to some one place in the neighbourhood, and to which place she often said, when she found the fit coming upon her, that she was to go; and after she had gone to the place of her destination, if she did not there awake, she came back in the same direction, though she did not always keep the high road, but frequently went a nearer way across the fields; and though her road, for this reason, was often very rough, she never fell, notwithstanding the violence with which she ran. But all the while she ran, her eyes were quite shut, as her brother attests, who often ran with her to take care of her, and who, though he was much stronger, older, and cleverer than she, was hardly able to keep up with her. When

[r] Dr. Pritchard, l. c. p. 434. sq. [s] Dr. Macnish, 171.

[t] See, for instance, *Med. Chir. Trans.* vol. v. and vii.

she told, before the fit came on, to what place she was to run, she said she dreamt the night before that she was to run to that place; and though they sometimes dissuaded her from going to a particular place, as to my house, for example, where they said the dogs would bite her, she said she would go that way and no other. When she awoke, and came out of her delirium, she found herself extremely weak, but soon recovered her strength, and was nothing the worse for it, but, on the contrary, was much the worse from being restrained from running. When she awoke and came to herself, she had not the least remembrance of what had passed while she was asleep. Sometimes she would run upon the top of the earthen fence which surrounded her father's little garden; and though the fence was of an irregular figure, and very narrow at top, yet she never fell from it, nor from the top of the house, upon which she would sometimes get, by the assistance of this fence, though her eyes were then likewise shut." Once, in a fit, she had a violent desire to drink of water from a particular well, and on their giving her other water, "she would not let it come near her, but rejected it with great aversion; but when they brought her water from this well, she drank it greedily, her eyes being all the while shut. Before her last fit came upon her, she said that she had just three leaps to make, and she would neither leap nor run more. And accordingly, having fallen asleep as usual, she leaped up upon the stone at the back of the chimney, and down again; and having done this three times, she kept her word, and never leaped or ran more. She is now in perfect health." [u]

In a recent American case of somnambulism, to which I shall presently refer, the patient, with her eyes closed, "sometimes engaged in her usual occupations, and then her motions were remarkably quick and impetuous; she moved with astonishing rapidity, and accomplished whatever she attempted with a celerity of which she was utterly incapable in her waking state."

In another, though the patient, in her fits of sleep, while her eyes were open and she was talking to her acquaintance, making ironical applications to them under feigned names, was perfectly insensible to pricking with needles, to wrenching her fingers, to brandy and hartshorn put into her eyes and mouth, Spanish snuff in

[u] *Ancient Metaphysics.*

her nostrils, a candle held so near her eyes as to burn the lashes, the noise of a loud voice in her ears or of a stone thrown against the back of her bed, she would nevertheless spring out of bed, and keep "the middle way between the bedsteads as well as when awake, and never come against them, turning dexterously round between the bedsteads and a concealed closet without even groping the way or touching the objects; and after turning round, she returned to her bed, covered herself with the clothes, and again became as stiff as at the commencement. She then awoke, as if from a profound sleep, and when she perceived, from the appearance of the bystanders, that she must have had her fits again, she wept the whole day for shame, and never knew what had happened to her during the paroxysm."[x]

In general patients are not easily awakened. Sometimes they are. Dr. Pritchard knew a man, who was accustomed to attend a weekly market, rise from his bed, saddle his horse, and proceed as far as the turnpike, which, being shut, awakened him. I have already given other examples. Although the persons mentioned were awakened with impunity, immediate death has occasionally been the consequence. Dr. Macnish mentions a young lady subject to sleep-walking, whose door one night was not, as usual, secured, so that she walked out into the garden; and there she was awakened by some of the family who followed her. But the shock was such that she almost instantly expired.[y]

One evening, about twelve or eighteen months ago, at Dresden, a young lady was observed walking upon the top of a house. The alarm was given, and a considerable concourse assembled. Every precaution was taken to prevent her from receiving injury in case of falling: the street was covered with beds, mattresses, &c. Meanwhile, the young lady, apparently unconscious of danger, came forward to the edge of the roof, smiling and bowing to the multitude below, and occasionally arranging her hair and her dress. After this scene had continued for some time, and the spectators were in the utmost anxiety for her safety, she at length proceeded towards the window of a room from which she had come. In their alarm, some of her family had placed a light in it, which the somnambulist perceived, and in

[x] M. Sauvage de la Croix. *Isis revelata*, vol. i. p. 33.
[y] l. c. p. 173.

consequence suddenly awoke, fell to the ground, and was killed on the spot.[z]

The curious occasional circumstance of our not remembering the points of a dream till dreaming of the same things again, has been strikingly noticed in sleep-waking.

Ritter[a] describes a somnambulist boy, who, on waking, recollected nothing that occurred in his sleep, but could talk of other matters. On falling asleep again, he could resume his discourse just where it had been interrupted by his waking; on waking again, he would know nothing that had transpired in his sleep, but recollect what had been said to him last when awake; and thus, says the simple reporter, it appeared as if he had two souls, one for the state of sleep, and the other for the period when he was awake. My patient recollected the occurrences of her paroxysms of extatic delirium in her paroxysms only. (*Suprà*, p. 630.)

Even in the mixed stupefaction and excitement of intoxication the same phenomenon has presented itself. "Dr. Abel informed me," says Mr. Combe, "of an Irish porter to a warehouse, who forgot, when sober, what he had done when drunk: but, being drunk, again recollected the transactions of his former state of intoxication. On one occasion, being drunk, he had lost a parcel of some value, and in his sober moments could give no account of it. Next time he was intoxicated, he recollected that he had left the parcel at a certain house, and there being no address on it, it had remained there safely, and was got on his calling for it."[b] This man must have had two souls, one for his sober state, and one for him when drunk.

The paroxysms of intermitting insanity are sometimes followed by oblivion of their events in the lucid interval, and a fresh paroxysm brings them all to the memory. Here, of course, are a rational soul and a mad soul in the same tenement.

Shakspeare, aware of the frequency of the phenomenon in sleep-walkers, represents Lady Macbeth as walking in her sleep with her eyes open, though he makes the royal physician ignorantly infer that therefore she must be awake, and a gentlewoman of the court know better, —

[z] *Isis revelata*, vol. i. p. 320. sq.

[a] *Psychological Magazine*, vol. i. No. 1. p. 69.

[b] *A System of Phrenology*, ed. iii. p. 521.

"*Doctor.* You see her eyes are open.
Gentlewoman. Ay, but their sense is shut.

But a remarkable circumstance is that, though a particular sense appear torpid, it may be alive to *some* impressions. A sleep-waking female, mentioned by Lorry, could not be made to see or hear or be aware of the presence of any person but one, and him she evidently saw, and to him she used to address herself upon the subject of her dream. Dr. Pritchard gives an account of a boy who, in these paroxysms, became insensible to all external impressions, except that, when he happened to play on the flute, he sometimes perceived if other boys began to accompany him, and then evidently directed his attention to them.[c] The insensibility to external impressions in sleep-waking, as in common sleep, is not in the organs of sense or the tract of their nerves, but in the portion of the brain most immediately connected with them: and, if these portions are not torpid, and at the same time there is excitement either of a particular *kind*, as musical, for instance, or in connection with a particular individual, those impressions tell which are in relation with the excitement, while those which find all torpid with which they might be in relation are unnoticed. But, for this singular partial sensibility to take place, the portion of the brain in connection with the very extremities of the nerve of sense cannot be torpid: for, if it were, no excitement in relation to any object of that sense, no attention or direction of the thoughts, would avail. Such a portion is torpid sometimes. Negretti sat down to eat a bowl of salad: yet, though his thoughts must have been upon it and his attention directed to it, he ate first cabbage and then pudding, which his friends substituted for it in succession, without perceiving the difference. When he had asked for wine, he did not detect that they gave him water; when snuff, that he received coffee. On the other hand, if the portion of the brain in connection with a particular sense is not asleep, its objects may be perceived though presented unexpectedly. Signor Augustin heard slight sounds at a distance, and was set listening. I therefore cannot agree with Dr. Pritchard, who attempts to explain these differences entirely by generalising the remark made on Castelli's case by the reporters, and saying that, "when attention is by a voluntary act directed to the particular operation of

[c] *On Disorders of the Nervous System, &c.* p. 409.

sense, the perceptive faculty of the sleeper is perfect, even remarkably acute. But when his mind is distracted, his reverie presenting different objects, even loud sounds are imperceptible to him." If, on the other hand, a particular sense is not torpid, but the portion of the brain in immediate connection with its nerves sensible, impressions may not be perceived, on account of the excitement of the thoughts — of attention, in another direction; just as, when in study we become wrapt in thought, we cease to hear the chimes of a clock in our apartment: and, though a sensation take place, the mind may form a wrong judgment if imperfectly excited towards it; as when Negretti, if a blow was given him with a stick, or a muff was thrown at him, fancied in each instance it was a dog, — mistakes similar to those which we make, if addressed or touched when deep in thought. And, although a sense be nearly torpid, a powerful partial excitement and concentration of thought, such as happens in common dreaming when we successfully effect what we had attempted in vain when awake, may cause very slight impressions on that sense to be accurately perceived. Probably, not merely is the *intellect* partially much heightened, in some instances; but a *sense* rendered exquisite, so that a person may see with the eyes so much closed that others consider them shut, and perceive in what others call darkness. I shall mention a case of extraordinary sensibility to light at p. 653. *infrà*. The sensibility sometimes either quickly varies or becomes very peculiar in the paroxysm. For, while it was certain that my little patient in herdelirium saw perfectly all round her, I darted my finger rapidly towards her eyes, but the pupil did not lessen nor the lids wink. The same extraordinary phenomenon occurred in a case presently to be quoted from Dr. Abercrombie, and in another from an American journal. I made the experiment repeatedly on different days. Another singularity was that, though she evidently saw well around, she declared, on my holding up one finger, that there were two; on holding up two, she declared there were four; on holding up four, she said there was a large number. On presenting a watch to her, she could not tell the time, though she attempted carefully: she at length pronounced an hour, and persisted in it, but quite wrong. Once while looking at Baron Dupotet, she said he had a great many eyes, and then that his eyes turned right round in his head. In the delirium I always noticed one eye to be too near the nose. The

following case also exhibited either rapid changes or an extraordinary state of sensibility. Dr. Darwin relates the case of a young lady about seventeen years of age, who, every day for five or six weeks, had fits of violent convulsions, then retchings, next equally violent hiccups, then tetanus, and at last sleep-waking, becoming insensible, yet singing, quoting whole passages of poetry, and holding conversations with imaginary persons, and coming to herself with great surprise and fear, but with no recollection of what had happened. At length she could walk about the room in the fit without running against the furniture, and evidently had some external sense: for she took a cup of tea and expressed a fear that there was poison in it; and seemed to smell at a tuberose, and deliberated about breaking the stem, because it would make her sister so charmingly angry; once heard a bell, was less melancholy when the shutters were open, and impatient if a hand was held over her eyes or her hands were held down, saying, "She could not tell what to do, as she could neither see nor move."

I conceive that those portions of the brain that are connected with the nerves of the respective organs of sense may all be completely torpid; or only some of them; or not completely torpid; or some in one degree of torpidity and others in another; and that they may appear torpid when they are not, or more torpid than they are, from the attention being dull or directed to another quarter: that one or more may become exquisitely sensible, while the others are in various degrees of torpidity, and may fluctuate rapidly between sensibility and insensibility or be peculiarly deranged: that the partial intelligence of the brain may be of various degrees, and have various directions, and may act powerfully with very little external sense: and that great variations in every point may take place in the fits of the same individual, and even in the same fit. If to these considerations we add the force of habit, we shall explain all that is usually observed in sleep-waking. Negretti laid the table, waited, and put the things away, by habit; and, in places to which he had been accustomed, showed no confusion, but went through his business cleverly; whereas, in a place of which he had no distinct knowledge, he felt with his hands all around, and showed much inaccuracy. He struck himself against a wall severely, and against a door which they had intentionally shut. Galen says that he himself walked about in his sleep a whole night, till he awoke by striking against a stone that hap-

pened to be in his way. Habit will also be far more successful in the partial excitement of sleep-waking. The man who often went in his sleep to draw wine in the cellar had no difficulty, but if he accidentally awoke he had to grope his way back. He knew the way well, but when awake had the emotion of fear to check him; and, in addition to this, probably had not the intensity of partial excitement which prevailed in his sleep, so that his habit was less effective.

But, though partial torpidity and partial excitement, of various degrees and in various points of the brain, and excitement in relation to various individual external objects, and some derangement of the natural sensibility, may explain all the cases which I have described, some persons explain many of the phenomena by the operation of a new sense diffused throughout the surface, but most intense at the epigastrium and fingers, and adduce extraordinary cases in proof of their belief.

" There are, therefore, somnambulists who see," says Gall, after relating the cases quoted in p. 630. sq., "and the opinion of certain visionaries, who think that the perception of external objects takes place in somnambulists only by the internal senses, is refuted.

" Experience proves that somnambulists who have their eyes shut hit themselves when obstacles unknown to them are placed in their way, that they fall into holes, &c. When, with their eyes shut, they find themselves in a place familiar to them, they find their way, like blind people, by the aid of local memory.

" Just as the eye and ear may be awake in dreaming, so may other external senses. We perceive exhalations that surround us; we recognise a bitter or sweet taste of the saliva after a bad digestion; we feel heat, cold, &c. Some persons think that somnambulism is a completely extraordinary state, because somnambulists execute, during their sleep, things which they could not accomplish awake: they clamber on trees, roofs, &c.

" All astonishment ceases as soon as we reflect upon the circumstances in which we do the boldest things, and upon others in which we cannot. Any one in a balcony, furnished with a balustrade, could look down from a very high tower, and without resting against this balustrade. We walk without tottering upon a plank placed upon the *parquet*. To what will not boys accustom themselves in their rash sports? What do not moun-

taineers in the pursuit of the chamois, rope-dancers, tumblers, &c. perform? But take the balustrade from the balcony: let us but discover an abyss to the right and left of the plank, and we are lost. Why? Is it because we are not in a condition to walk upon the plank? No. It is because fear destroys our confidence in our powers.

"Now let us judge of the somnambulist. He sees distinctly what he is about to do, but the organs which would warn him of the danger are asleep: he is therefore without fear, and executes whatever his bodily powers allow him successfully to attempt. But wake him: instantly he will perceive his danger, and give way.

"All this is sufficient to establish that the nature of dreams and of somnambulism furnishes fresh proofs of the plurality of the organs."

Let us, however, now inquire what phenomena of a marvellous kind have been recorded.

We have the authority of an archbishop of Bordeaux for the case of a young ecclesiastic who in his sleep would rise, go to his room, take pen, ink, and paper, and compose good sermons. When he had finished a page, he would read it aloud, and correct it. Once he had written *ce divin enfant;* in reading over the passage he substituted *adorable* for *divin:* but, observing that *ce* could not stand before *adorable*, he added *t*. *The archbishop held a piece of pasteboard under his chin to prevent him from seeing the paper on which he was writing; but he wrote on, not at all incommoded.* The paper on which he was writing was then removed, and another piece substituted; but he instantly perceived the change. He wrote pieces of music in this state, with his eyes closed. The words were under the music: and once were too large, and not placed exactly under the corresponding notes. He soon perceived the error, blotted out the part, and wrote it over again with great exactness.

A sleep-waking boy at Vevey, thirteen years and a half old, was declared, by a committee of the Philosophical Society of Lausanne,—Dr. Levade, and Messrs. Regnier and Van Berchem, not only to discover things well by his touch, and to write, and detect and correct any error he might have made, but to write, with the same distinctness as before, what his master dictated, though a *piece of paper was put before his eyes.* I relate no other

wonders of him, because I lay no stress upon the circumstance of sleep-wakers sometimes apparently seeing in the dark or with their eyes shut, though it is unquestionable and occurred even in some of the cases which I have already detailed, since the sight may become so acute that darkness is light to them, and since the smallest aperture of the eyelids may be sufficient to see through, and access may not be totally impossible to the eyes, though they appear closed or are even bandaged. A case is related, by Professor Feder, of a Gottingen student, who, in his sleep, with his *eyes shut*, would select music, place it on his harpsichord, and play it expressively; write letters; tell that it snowed, and that a man was at the window of the opposite house, &c. A ropemaker at Breslau, would be seized with sleep in the midst of his occupation, and, when his surface, ears, and nose were perfectly insensible, and his *eyes firmly closed*, continue his business just if he had been awake, pursue his journey without missing the road, and, finding some timber in a narrow lane, pass over it as well as if awake, and once on horseback, in passing the river Ilme on his way to Weimar, let his horse drink, and drew up his legs to prevent them from getting wet; yet "he could not see when his eyes were forced open." [d] Dr. Schultz of Hamburgh speaks of a girl of thirteen, who, in her paroxysms, recognised all colours, and the number and stripes of painted cards, not only with her eyes closed, but *bandaged*.

In America, Dr. Belden, in 1834 [e], very minutely detailed an extraordinary case, in which the sleepwaker, a girl of sixteen, did, in her paroxysms, every thing with the greatest accuracy that she was accustomed to do when awake, threaded needles, read, wrote, and corrected any omissions, although in darkness and with her eyes closed and most carefully bandaged. Sometimes she evidently saw and was directed by her eyes; for, when once the stair-door, which was usually left open, was fastened by the blade of a knife placed over the latch, she rushed from her room impatiently, and, extending her hand before reaching the door, seized the knife and threw it indignantly on the floor, exclaiming, "Why do you wish to fasten me in? Her eyes were sometimes wide open, and the

[d] These cases are quoted in *Isis revelata* from the *French Encyclopædia*, vol. xxxviii.; *Encyclopædia Britannica*, SLEEPWALKER; *Psychological Magazine*; *Acta Vratislav.* class iv. art. 7.

[e] *Journal of the Medical Sciences*, No. 28.

pupil dilated and apparently insensible. Generally they were closed, and that they then were extremely sensible would appear, because she almost invariably supposed it was day, and when advised to retire usually replied, "What, go to bed in the day-time?" Once, in the darkness of night, while preparing dinner, she observed a lamp alight and put it out, saying she did not know why people wished to keep a lamp burning in the daytime; and once, when the light of a lamp was reflected on the closed eyelid by a concave mirror, so diffused that the illuminated space could scarcely be distinguished, it caused a shock of such severity that she exclaimed, "Why do you wish to shoot me in the eyes." Some uneasiness was produced even when she was awake, although the experiment produced no pain in the eyes of the reporter. It is particularly worthy of notice, that once when she was writing out a song, with a black silk handkerchief stuffed with cotton bound over her eyes, and a person interposed a piece of brown paper between her eyes and the paper on which she was writing, she seemed disturbed and cried out, "Don't, don't." An apple being held before her, but higher than her eyes, which were well bandaged, she raised her head, as any one would if desirous of looking at something above him, and when asked its colour, answered correctly. She learnt backgammon in her sleep, and so well and quickly that she soon beat Dr. Butler, an experienced player: sometimes, like many somnambulists, she displayed an astonishing power of mimickry, though she never exhibited the smallest trace when awake. Her personality was double, for she recollected from paroxysm to paroxysm and forgot all in her waking state: playing backgammon, for instance, better in the second paroxysm in which she attempted it, and, when the paroxysm was over, declaring she never saw it played, and not knowing even how to set the men. The paroxysms were attended by pain, at an invariable spot in the left side of the head, often so excruciating, that she used to cry out, "It ought to be cut open, it ought to be cut open." As her sleep-waking became less perfect, her face less flushed, and her head less painful, she required more light: for once she declared, in her paroxysm, that she could not read with her eyes shut; and, when the doctor placed his fingers before her eyes, she could not read a word and said it was total darkness.

Lest, however, such cases as the four last should be doubted

in this country, let us remember that Dr. Abercrombie relates the history of a poor girl, who, when seven years of age, looked after cattle at a farmer's, and slept next a room often occupied by an itinerant fiddler of great skill and addicted to playing refined pieces at night; but his performance was taken notice of by her as only a disagreeable noise. She fell ill, and was removed to the house of a benevolent lady, whose servant she became. Some years after this change, she had fits of sleep-waking, in which, after being two hours in bed, she became restless and began to mutter; and, after uttering sounds precisely like the tuning of a violin, would make a prelude, and then dash off into elaborate pieces of music, most clearly and accurately, and with the most delicate modulations. She sometimes stopped, made the sound of retuning her instrument, and began exactly where she had left off. After a year or two she imitated an old piano also, which she was accustomed to hear in her present residence: and, in another year, began to talk, descanting fluently, most acutely, and wittily, and with astonishing mimickry and copious illustrations and imagery, on political, religious, and other subjects. For several years she was ignorant of all around her in the paroxysms; but, at about the age of sixteen, she began to observe those who were in her apartment, and could tell their number accurately, though the utmost *care was taken to have the room darkened;* and, when her eyelids were raised, and a candle was brought near the eye, the pupil seemed insensible to light. She soon became capable of answering questions, and of noticing remarks made in her presence, and in both respects showed astonishing acuteness. "Her observations, indeed," says Dr. Abercrombie, "were often of such a nature, and corresponded so exactly with characters and events, that by the country people she was believed to be endowed with supernatural power.

"During the whole period of this remarkable affection, which seems to have gone on for ten or eleven years, she was, when awake, a dull awkward girl, very slow in receiving instruction, though much care was bestowed upon her; and, in point of intellect, she was much inferior to the other servants of the family. In particular, she shewed no kind of turn for music."[f]

[f] *On the Intellectual Powers*, 4th edit. p. 294.

How much duller so ever than the rest of the servants this poor girl was considered, it is evident that she had observed greatly and acquired a store of knowledge. She was probably very reserved and contemplative, and could learn in her own way only. The really cleverest children are often considered stupid; while the quick and prattling, who turn out but ordinary adults, are thought prodigies.

Now at last comes the special wonder: greater than that of the young priest or the Swiss boy. Dr. Petetin, perpetual President of the Medical Society of Lyons about fifty years ago [g], had a cataleptic patient who seemed perfectly insensible. While addressing her loudly with the view of rousing her, he accidentally moved his face from her head towards the epigastrium in finishing the sentence; when to his surprise she heard him distinctly. He made many trials, and found the same thing invariably take place: and then, making experiment after experiment, he discovered that she could taste, smell, and read, and read even through an opake body, by the epigastrium: and at last he found that speaking at one end of a conductor, the other end of which rested on the epigastrium, was quite sufficient to make her perceive. Van Helmont, a century and a half before, had declared that, after tasting some aconite, his head felt strange, and all his intellect seemed to have left his head and taken up its residence for two hours at his epigastrium. He was giddy for two hours, and then in his ordinary condition. [h] The simple explanation is, that Van Helmont was delirious through the narcotic; and at page 40. *suprà*, I mentioned that on one occasion of mental transport he actually saw his little soul in his stomach. Dr. Petetin tried other sleep-waking patients [i], and found the same phenomena; and in some that the ends of the fingers and toes had the same power as the epigastrium. Dr. Petetin secretly placed pieces of cake, tarts, &c. upon the epigastrium, and immediately the peculiar taste was perceived in the mouth: if they were wrapped in silk, there was no taste till they were uncovered. One patient distinguished a letter folded four times, and inclosed

[g] *Mémoire sur la Découverte des Phenomènes que présentent la Catalepsie et le Somnambulisme.* Par M. Petetin. 1787.

[h] *Demens idea*, § 11. sq.

[i] *Electricité Animale prouvée par la Découverte des Phenomènes Physiques et Moraux de la Catalepsie Hystérique, et de ses Variétés.* 1800.

in a semi-transparent box held by Dr. Petetin upon her stomach. Another patient, when a letter was placed upon her finger, said, "If I were not discreet, I could tell you the contents: but to prove that I have read it, there are just two lines and a half." She correctly enumerated the chief articles in the pockets of the company: and a Madame de St. Paul, if interrogated mentally only by means of a metallic chain, one end of which was placed on her epigastrium and the other on the interrogator's lips, or of a chain made by several persons, the first of whom placed his hand on her epigastrium and the last whispered in the hollow of his hand, heard perfectly, though insensible to the loudest voice if the chain were interrupted by a piece of sealing-wax.

These things seem calculated only to excite a smile; but, from that time to this, similar cases have been recorded in different countries. Baron de Strombeck published one, in which the phenomena were observed, noted down, and attested by three physicians as well as himself.[k]

Dr. Joseph Frank[l], in 1817, gave an account of a violent case of hysteria and catalepsy, in a married woman twenty-two years old, who, in her fits, was insensible to light, pricking, and the loudest sound, but heard the moment the doctor approximated his mouth to her epigastrium and spoke in a low tone, not audible to the bystanders. Still he spoke: and be it also known that the woman was so credulous as to have given herself up to certain empirics and old women; "so ardent in putting her trust in God that she prayed fervently day and night; and laboured under hysteria, which often gives a strong disposition to deceive and excite the interest and wonder of others. While comatose, she both tasted sugar and water applied to her epigastrium, though after the coma she could say only that something moist was there but could not tell what, and could hear nothing except the doctor's hand was on her stomach. When asked the name of a gentleman present, she was silent: but, as soon as Dr. Joseph Frank, whose hand was always on her stomach, took him by the hand, she

[k] *Histoire de la Guerison d'une jeune Personne par le Magnétisme Animal produit par la Natur elle même.* Par un Temoin oculaire.

[l] *Praxeos Medicæ Universæ Præcepta.* Leipsiæ, 1817. P. ii. vol. i. p. 495. sqq.

at once told his name; and, indeed, answered questions put to her by any person, and told all their names, provided they formed a chain by their hands among themselves and with Dr. Joseph Frank, and he had his hand on her stomach. The woman was always so obliging when the doctor had his hand on her stomach, that it must have been fortunate his name was Joseph. Dr. Bertrand gives several others, which had occurred up to the appearance of his work in 1826[m], and contends that the phenomena repeatedly appeared in the hysterical excitement of the Quakers, of the Cevennes, the Nuns of Loudun, and the Convulsionaires of St. Medard.

A case more recently occured in the Jervis Street Hospital, Dublin, and is recorded in a clinical lecture by Mr. Ellis.[n] A cataleptic female, Mrs. Finn, gave no signs of hearing an Æolian harp played close to her ears; and, after the fit, declared she had not heard it, nor recollected that cold water was dashed upon her, though it had made her scream violently. She had been spoken to on the epigastrium, palms, and soles, but it was not till long afterwards, in thinking on what had happened to her during the last two months, that she remembered having heard a voice one day on the pit of her stomach. "On the occurrence of the first cataleptic attack after this conversation, she was spoken to in the epigastrium as previously; and on the subsidence of the fit, she could report with accuracy every word addressed to her through this region. This experiment was often repeated, and always attended with similar results. She could hear the lowest whisper, or the ticking of a watch."

One occurred in a man in the Hospital della Vita at Bologna, in 1832[o], and it was probably the fame of this that caused the same city to be happy enough soon afterwards to produce another in a female who in her coma talked Latin, which she had never learnt, gave an accurate anatomical description in technical terms of the solar plexus, pancreas, heart, and first vertebra, detailed the pathological state of a lady whom she did not know, and the situation of places in Paris where she had never been; extracted roots of numbers, for instance of 4965,

[m] *Du Magnétisme Animal en France.* Par A. Bertrand. Paris, 1826.

[n] *Lancet,* May 2. 1835.

[o] *Bulletin des Sciences Médicales.* Bologna, 1832. or *Gazette Médicale.* Paris, Nov. 24. 1832.

though she had never learnt more than the first four rules of arithmetic, and unconsciously detailed various philosophical systems, and discussed others which were mentioned to her.[p]

Oh the waste of labour, time, and money spent in education, and books, and philosophical apparatus, when mesmerism is such a ready help! One hysterical young lady at Grenoble, whose case was read to the Philomathic Society of Paris, was able to get through a great deal of business, for in copying letters she read with her left elbow while she wrote with her right hand.[q]

I do not doubt the truth of the narration of all the cases of sleep-waking, excepting those in which there was extraordinary knowledge, patients saw through opaque bodies, or the epigastrium, fingers, and toes, were the seat of extraordinary perceptions: and these I shall defer considering till I speak of sleep-waking induced by art. The cases are too numerous, have occurred in too many places, at too many times, and under too many circumstances, are too naturally and respectably told, are all too similar and yet too diversified, and yet not marvellous enough, for a reasonable mind to doubt them. They are all evidently examples of partial torpidity and partial excitement, and some also of partial extraordinarily rapid change or peculiar derangement of various portions of the brain, and perhaps of some other parts of the nervous system. The phenomena ascend from the faintest common dreaming, or even from disturbed sleep, through plain sleep-walking, and somewhat singular performances, to the most astonishing. Every degree is morbid; and, to view the cases as any thing else than instances of bodily derangement, would be absurd. The attacks are sometimes periodical[r]; take place in bad health, and are worse in proportion as the health is worse; are frequently united with other diseases of the nervous system, — catalepsy, hysteria, epilepsy, delirium, &c., or are changes from these or change to these; occur, unless when chronic, most frequently when the

[p] See *Lancet*, Feb. 16. 1833.

[q] Bertrand, l. c. p. 458. sqq.

[r] Martinet mentions a watchmaker's apprentice who had an attack once a fortnight, and did his work well, astonished on awaking at the progress he had made. The fit began with heat at the epigastrium rising to the head and followed by confusion and complete insensibility, his eyes being fixed and staring. Negretti's attack was always in March. See *suprà*, p. 639.

sexual feelings and functions are establishing themselves and the former not yet gratified [s], and the whole young mind is undergoing the changes of the adult period; are often attended by pain in the head, and all the common symptoms of deranged distribution of blood and of morbid sensibility in that part; they have all the same exciting causes as other nervous diseases; the pre-disposition to them is sometimes hereditary [t]; and they require the treatment common to all other nervous diseases. To consider them as examples of the soul acting independently of the body in the disease, is discreditable to an author of the present day. Old authors regarded common dreams in this point of view; and I formerly quoted the remark,—that the soul must work very strangely, when so disencumbered of the activity of the brain, for us to dream "such perilous stuff as dreams are made of." (*Suprà*, p. 626.) The cases of double consciousness in those affected with the disease (*suprà*, p. 646.) ought to prove two souls to exist; and one of them to be able to get drunk alone in the case of the Irish porter, whose second consciousness showed itself only in his intoxication. Sleep-waking is neither more nor less than diseased sleep. The torpor far exceeds that of common sleep, and is a coma like that of apoplexy, hysteria, or epilepsy; though in the first of these the brain generally is prevented by pressure only from performing its functions. In epilepsy we have equal coma: in a moment the patient becomes insensible to mechanical violence, the loudest noise, and the strongest light: even when the disease is partial, as in two little boys whom I attended, in whose fits the eyelids only were convulsed and the head drawn back, the insensibility came in a minute, and as suddenly ceased, and was

[s] Of 50 cases which I have counted, 21 were apparently permanent, and 18 such occurred in males; 16 patients were females, and 13 of these from 13 to 25 years of age, and unmarried; of the 34 males, 16 were from 10 to perhaps a little above 20 years of age, and apparently all unmarried: 7 of the young patients were 16 years old. The chronic cases probably are more rare, but appear so large in proportion from attracting greater attention and therefore being oftener recorded.

[t] "Negretti's son was subject to it from boyhood." Dr. Willis knew a family in which the father and all the sons were sleep-wakers, and "the sons in their nightly discursions ran against and awakened each other." Dr. Pritchard, *Treatise on Insanity*, p. 459.

such that, during the minute of the fit, a pistol fired off in the ear of one was unnoticed. In common epilepsy and sometimes in hysteria we have coma, —perfect insensibility, and at the same time such high excitement of the parts of the nervous system which move the muscles that violent convulsions occur. In sleep-waking, it is an intellectual, and sometimes also moral, part of the nervous system that is excited in the midst of the torpidity, sometimes one part, sometimes another; and, in some instances, probably a heightened partial sensibility of parts concerned in external sensation. In neuralgia we have fits of violent excitement of nervous parts concerned in sense; in palsy of sensation, the reverse. In tonic and clonic spasms we have excitement of nervous parts concerned in motion; in palsy of motion, the reverse. We have these two portions sometimes in opposite conditions. The same holds good precisely of all parts of the brain: and these conditions, in all these cases, and in all other diseases of the nervous system, as fits of morbidly excessive sleep, may be purely functional, and occur in paroxysms: nay, most rapid changes of external sense may probably take place in the paroxysms, or even alterations different from changes of mere degree. Some may have ecstatic delirium, in which there is no loss of external sense, nor coma, but a sudden change in the internal feelings, so that the patient talks and acts like a fool, and in a moment the whole may cease and be forgotten, and the patient be as before: and this may be interchanged with fits of sleep-waking.

By certain processes, such as passing the points of the fingers at a short distance from a person in a direction from the face down the arms, trunks, and legs, with a degree of energy, the state of sleep, or sleep-waking, may actually, we are told, be induced. It is then termed *magnetic*, and the whole phenomena, *animal magnetism*. The patient becomes insensible to all around, but may have the inward senses augmented as in common ecstasis,—may sing well for the first time in his life, and talk so unguardedly as to disclose secrets. The external senses may become so impene-

trable, that a pistol fired in the ear is not heard, nor melted wax dropped on the body felt, nor ammonia applied to the mouth or nostrils perceived, although the gentlest word of the operator (*magnetiser*) is heard and answered, water similarly treated (*magnetised*) by him tasted and found ferruginous, and the gentlest touch of him recognised. A delightful feeling of ease and lightness is experienced, the body grows warmer, and perspires freely, though sometimes anxiety, palpitation, slight convulsions, and wandering pains take place. On the first attempt these occur generally without sleep-waking, and it is only after many trials (and sometimes they continue fruitless) that such a state is induced. On coming out of the sleep-waking, the person is unconscious of all that has occurred; but, when thrown into it again, recollects the whole and converses on it. The magnetiser can put an end to this state at pleasure: and, when he is a good magnetiser and the patient very susceptible, a single movement of the hand may instantly magnetise, and even knock down and kill; a look may magnetise: and we are told that all these effects may sometimes be produced at great distances by the mere volition of the magnetiser.

But this is not all. We are assured that matters often go much farther; that a person can often be so highly magnetised, not only as to taste magnetised water and recognise the magnetiser by hearing and touch, but even to perceive objects of sight, hearing, taste, and smell, by the epigastrium, fingers, and toes,—by the organ of touch, so as to read a letter by these parts [u], even though it be folded in several envelopes; nay more, to discover a person in the next room, though a wall intervene; to foretell events entirely relating to others, and describe things going on at incalculable distances, as well as learn the thoughts of persons present; to relate the most minute points regarding persons who touch them, though never seen before; to see the interior structure of his own body, and describe the seat and appearance of a diseased organ, predict the future events of a disease of either himself or others, and point out the remedy. However, I am not aware of any anatomical discoveries having ever been made, and

[u] This reminds one
"Of Rosicrusian virtuosis,
Who see with ears and hear with noses." *Hudibras.*

presume that blood would never have been seen flowing up the cava inferior and down the aorta unless Harvey had first taught the circulation; and I observe that the remedies always depend upon the country and the period, — that, in Paris, leeches to the anus and vulva, ptisans, baths of Barèges, and extract of nux vomica if the person has heard of Dr. Fouquier's treatment of paralysis, gummed water and gummed lemonade, diet drinks of borage, and M. Dupuytren's remedy of mercurialised milk procured by milking a goat previously rubbed with mercurial ointment, are ordered: and suppose that calomel, sulphate of magnesia, porter, and port wine would be called for in England; and that neither quinine for ague, nor iodine for bronchocele, were ever commanded before Pelletan and Dr. Coindet had made known their virtues.

This state is called *hellsehen*, *clairvoyance*, or *lucid vision;* and, if the lucidity extends to all objects of space and time, so that things long past relating to others, things passing at a great distance, and things to come, are revealed, it is *universal lucidity*, or *allgemeine klarheit*.

They affirm not only that water can be magnetised so as to taste chalybeate, but inanimate bodies made conductors no less than a chain of persons.

It was said to have been discovered by Dr. Mesmer, a very glutton in all that was marvellous, in the latter part of the last century, who, knowing that the magnet was much employed as a remedy, and hearing from Hell, a Jesuit, the professor of astronomy at Vienna, that he had cured himself by magnetic plates of a severe cardialgia, opened a house for curing every disease in this way, and began to imagine the existence of an universal magnetic power, distinct from that of the common magnet, depending upon a fluid pervading all living and inanimate matter, and the source of all in art and nature. To throw this fluid into persons, — to magnetise them, he manipulated as we have mentioned, and employed other processes which are now omitted. He travelled, performed many great cures, and often failed; was praised, and deservedly abused, for he adopted the course of all quacks, whether regular or irregular practitioners. He depreciated others, affected mystery, and extolled himself. He insisted that there was but *one health*, *one disease*, and *one remedy*, which

remedy, of course, *he* had discovered. He rubbed and pressed his patients, and touched them with an iron rod, made them sit silently in circles, in a room rather darkened and furnished with mirrors, music playing all the time. After him, a school was established at Lyons and Ostend by a Chevalier Barbarin, where no manipulations were used and all was accomplished by the energy of the operator's volition. Faith removed their mountains, and their motto was "Veuillez le bien — allez et guérissez." At a third school, that of the Marquis de Puysegur at Strasburg, very gentle manipulations were employed, and the operators made them frequently at some distance from the patient.

Such results appeared as caused a commission of inquiry to be ordered, in 1784, by the government of France. The whole was ascribed to imagination, imitation, and touching; the matter declined, and Mesmer retired to Switzerland. Still it was practised not only in the three first schools of Mesmer, Barbarin, and Puysegur, but assiduously cultivated in many parts of Germany, and lingered still among us, for a Miss Preston in Bloomsbury Square, who died lately, practised it during the best part of her life; and I recollect that, about twenty years ago, numbers went to a magnetiser at Kennington. I some years ago saw lectures upon it advertised in the prospectuses of the medical courses in German universities, — at Heidelberg for instance. Of late the subject has been revived among the physicians of Germany and France, and at Berlin a magnetic clinical ward has been opened; and a commission of the Royal Academy of Medicine sat in 1826, in Paris, to inquire into it anew.

J. B. Van Helmont, born at Brussels in 1577, certainly shows in his works that he was well acquainted with animal magnetism and practised it. His cures by its means, were, like most miracles, ascribed by the wicked to the assistance of the devil. His language is so distinct, that "we might almost conceive," says Mr. Colquhoun, "that we were reading the works of some disciple of Mesmer:" and indeed many Continental and English writers of the sixteenth and seventeenth centuries contended for an universal magnetic power, which produced the dependence and reciprocal action of bodies, and especially the phenomena of life; and allowed extraordinary effects to be produced in another living being, even at a great distance, by the will or imagination of

man. Cornelius Agrippa ab Nettesheym asserts that a man naturally, and without any miracle, unassisted by the Holy Spirit or any other, may convey his thoughts in the twinkling of an eye to another at any distance: "et ego id facere novi, et sæpius feci. Novit idem etiam fecitque quondam Abbas Trithenius."[x] A professor of philosophy at Padua, Petrus Pomponatius, born in 1462, had contended, before Van Helmont, for the power of the imagination or will of one person to send forth an influence upon another; and enumerated the conditions of the exercise of this power in nearly the terms of modern magnetisers. He too surpassed all, for he point blank declares that inanimate matter may obey this influence. "Cum hominis animæ voluntas et maxime imaginativa fuerint vehementes, venti et reliqua materialia sunt nata obedire eis."[y] Still Mesmer was the great restorer and modern establisher of magnetism in spite of great obstacles, so that the facts have been termed mesmerism; and, as the denomination animal magnetism is incorrect, and may lead to misconception, I shall in future adopt the word mesmerism. Even an arbitrary word in science is better than one devised from imperfect knowledge.

Those who ascribe all to imagination, consider the agitations and prophecies of the Delphian priestess of Apollo and the Sybils, and all ancient prophesies, the ecstacies of Dervishes and Santons, and of Shakers and Quakers, Irvingites, and of all ridiculous enthusiasts in what they strangely call religion, but which is all superstition and revolting irreverence to the infinite God of the universe, and the pretended miraculous cures of all ages, from the days of Serapis of Egypt to those of the blessed Paris of Paris[z], and of our own day, and of all countries, as only of a piece with mesmerism, showing how strongly fear or enthusiasm will work upon the brain and all the other organs. Others discover that magnetic influence has always been acknowledged, and even adduce a passage attributed to Solon, and preserved by Stobæus, to

[x] *De Occulta Philosophia*, l. iii.

[y] *De Incantationibus*. Basil, 1577. p. 237.

[z] Such ecstacies, &c. and miracles were worked at his tomb, that the government closed it, and forbad any more!

"De par le Roi, défense à Dieu
De faire miracle en ce lieu."

prove the antiquity of performing manipulations like those of magnetism to procure tranquillity :—

> "Τὸν δὲ κακαῖς νούσοισι κυκώμενον ἀργαλέαις τε
> Ἁψαμένος χειροῖν αἶψα τίθησ' ὑγιῆ."

> Sometimes the fury of the worst disease,
> The hand by gentle stroking will appease.

They adduce another from Plautus to show that manipulations were used in Rome to send persons to sleep. Mercury, proposing to knock a man down, says ironically in allusion to putting a child to sleep by gently rubbing it,—"Quid si ego illum *tractim* tangam ut dormiat." Sosia replies,—"Servaveris, nam continuas has tres noctes pervigilavi."[a] The Bible, of course, has not been left unquoted. When Naaman drove to Elisha's door in his chariot, and the prophet neither invited him in nor went out to him, but directed him to go and wash himself seven times in the Jordan, he was greatly disappointed at not being *touched* by the holy man. "But Naaman was wroth, and went away, and said, Behold, I thought, He will surely come out to me and stand and call on the name of the Lord his God, and strike his hand over the place, and recover the leper."[b] They believe there was mesmeric operation in these things: and consider them, and all the oracles, visions, prophecies, magic, and miracles of the pagan world, and those mesmerisers who are deists consider even the alleged supernatural things of the Jewish and Christian world, as not supernatural, but the result of this mighty power. Some are such enthusiasts, that they refer to mesmerism the instinctive application of our hand to a part in pain and rubbing it. The pressure and agreeable sensation go for nothing. The production of sleep by gentle friction is mesmeric. The mere circumstance of a gentle and continued impression has not the effect, because the sight of waving corn, the trickling of a brook, or the motion of rocking, does not produce sleep, nor can we rock or rub ourselves to sleep. The practice of the peasants in Bavaria, of rubbing their

[a] *Amphitryo*, act 1.

Consult *Lettres Physiologiques et Morales sur le Magnétisme Animal.* Par J. Amedée Dupeau. Paris, 1826.

[b] Kings, ii. 5. 11.

little ones from head to foot before putting them to bed, and the Oriental habit of uniting friction with the bath, is mesmeric. It is a great oversight in them not to adduce the habit of brute mothers to lick their little ones, as licking is friction with the tongue: but then to be sure brutes lick themselves also. It must however be an oversight not to adduce the habit of expecting our grooms to rub down our horses thoroughly night and morning. The verses of Martial referred to as implying mesmeric practice, are fully as applicable to grooms and horses:—

> "Percurrit agili corpus arte tractatrix
> Manumque doctam spergit omnibus membris." (iii. 82.)

Ignorant Mr. Mahomet and the rest of the shampooers! ignorant women who get your living as *rubbers* to the diseased! you imagine not that you are all *animal* magnetisers. The mesmeric process of rubbing horses, universal in civilized nations, would have been as good an example as that of a family in Dauphiné, "who have been in the habit of magnetising, from father to son, for centuries," and whose "treatment consists in conducting the *great toe* along the principal ramifications of the nerves;" or as that of the great toe of King Pyrrhus. It was irreverent to adduce a merely royal toe, when virtue is known to go out of the toes of his holiness the Pope, whose foot is therefore devoutly kissed by the faithful. The ancient medical employment of friction is mesmeric: and so must be all similar mechanical means; and among the rest the douche, which is liquid friction and percussion. I do not see why percussion, on the good effects of which treatises have been written, is not as mesmeric as friction. Mere touch does wonders, not by imagination, but mesmerically. A boy at Salamanca is mentioned who cured numberless persons merely by touching them with his hand. Many monks did the same. They forget to mention at the same time that an inanimate hand has great power in this way. It might be thought to have lost its mesmerism, but the mesmeric fluid is probably retained by the ligature around the neck, for the hand of a dead man just fresh from the gallows is to this day stroked over tumours to remove them. If any thing is mesmeric and not mechanical, this must be; as it is quite sufficient to draw the hand once across the swelling. Then again the efficacy of the *royal touch* has been known from the time of

Vespasian, who performed two miracles now ascertained to be mesmeric, to that of the Scandinavian princes, particularly St. Olaf in 1020, and even down to our modern kings, for whose mesmeric virtues the royal surgeon Wiseman, not through the mean craftiness of a courtier, but through philosophical conviction, stoutly vouches.[c] It is very remarkable that it was not simply hereditary and constitutional, but depended upon the individual being actually in office as king, and it is a loss, if not disloyal and radical, to consider our kings as no longer endowed with this virtue. George the Third gave up the pretension; but a king would still have thousands of patients if he would but practise: — a strong argument in favour of mesmeric influence. The practice of the imposition of hands and the manner of benediction are unquestionably mesmeric. The Chaldean priests are said to have practised this mode of treatment; as also the Indian Brahmins, and the Parsi; and the Jesuit missionaries inform us that the practice of curing diseases by the imposition of hands has prevailed in China for many years. The *imposition of hands* in blessing, and in the episcopal form of confirmation dates from the remotest antiquity, and originated in the view of imparting some holy effluence, just as I presume the imposition of the hands in correcting naughty boys and thrashing a man must have originated in the view of imparting something disagreeable. Among the eastern nations curative virtue was found to proceed from good men, if but even the *hem of their garment could be touched.* On the other hand, pernicious influence has always been acknowledged to proceed

[c] "I myself have been a frequent eye-witness of many hundreds of cures performed by his Majesty's touch alone, without any assistance of chirurgery; and those, many of them, such as had tired out the endeavours of able surgeons before they came thither." "This our chronicles have long testified, and the personal experience of many thousands can testify for his Majesty that now reigneth, and his uncle, father, and grandfather. His Majesty that now is having exercised this faculty with wonderful success not only here, *but beyond the seas,* in Flanders, Holland, and France itself." (p. 243.) The king always expressed his belief that the cure was effected by the grace of God, saying, at the time of the ceremony, "I touch, God heals;" and the pious and moral Charles II. touched 92,107 in twenty years, an average of twelve a day. *Chirurgical Treatises,* vol. i. p. 387. In 1684, Thomas Roswell was tried for high tresaon in having spoken contemptuously of the royal touch. — See *Wadd's Mems., Maxims, and Memoirs.*

from the eye. Every schoolboy remembers the passage in Virgil —

"Nescio quis teneros oculus mihi fascinat agnos."[d]

The word envy comes from invidio, and this from in and video. The Arabs dread the evil eye above all other mischiefs, and, if a stranger expresses admiration of any object belonging to them, they avert the calamity by passing over the object *a finger wetted with saliva.* Who is ignorant that the fierce look of man disarms the most ferocious brutes of their courage: that Pliny recommends breathing upon the forehead as a means of cure[e]; and that when a child complains the nurse often tells it she will blow away the pain. A dyspeptic friend of mine assured me that, on consulting a celebrated physician at an inland watering place, the doctor put his finger in mystic silence upon his forehead before feeling his pulse. Had it not been a little too late in the day, I have no doubt he would carry on such tricks like the notorious Dr. Streper, an Irish gentleman named Valentine Greatrakes, and a gardener named Leverett, who all, in the middle of the seventeenth century, cured thousands by stroking with the hand. Boyle and Cudworth both put themselves under the care of Greatrakes; and the Lord Bishop of Derry declared that he himself had seen "dimness cleared and deafness cured," pain "drawn out at some extreme part," "grievous sores of many months date, in a few days healed, obstructions and stoppages removed, and cancerous knots in the breast dissolved," by the Irishman. The gardener used to say that so much virtue went out of him, that he was more exhausted by touching thirty or forty people than by digging eight roods of ground. By means of the mesmeric fluid, some believers explain why a person cannot tickle himself; why, proverbially, when a friend is near, we think of him ("talk of the devil, &c."); and why, at the moment of death, distant friends have been said to see or hear the dying who happen to be thinking intensely of them so as mesmerically to influence them![f]

[d] *Eclog.* 30. [e] *Hist. Nat.* xxviii. 6.

[f] A short and luminous account and defence of mesmerism will be found in Dr. Georget's *Physiologie du Système Nerveux*, t. i. from p. 268. to 301. 1821. Drs. Hufeland, Treviranus, Sprengel, Reil, Autenrieth, Kieser, Carus, &c. have believed in it.

For a good and entertaining history of the mesmeric phenomena as they ap-

Many of the phenomena of mesmerism are unquestionable, and no more than occur in health or disease. To yawn and fall asleep, have catchings of different parts, and various little sensations, is nothing wonderful. To become more or less insensible to all around, and more or less powerless in one or more or all external parts, and have one or more of the intellectual faculties or external senses highly exalted beyond their usual pitch in the individual, to have not only trains of thought and inclinations, but to speak and sing, walk, write, &c., in the midst of extreme insensibility, and afterwards to forget what has occurred, or even to remember it when the same state returns, and only then, is no more than what we occasionally observe in patients. But when we are requested to believe that persons perceive objects of sight through dead walls; perceive objects of hearing and sight, smell and taste, with their bellies and fingers or toes; know what is going on at a distance, what will happen in regard to persons and places with which they have no connection, know the history of persons whom they never heard of before, but who are put in relation (*en rapport*) with them by contact, speak languages they never learned, display scientific knowledge which they never acquired, and make anatomical and pathological observations in their own frames and those of others, the matter is too

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peared in a patient at the Hotel-Dieu in 1820, see *Expériences Publiques sur le Magnétisme Animal, faites à l'Hôtel-Dieu de Paris.* Par J. Dupotet, 3d edit. 1826. The woman had gastritis and aortic aneurysm, and is said to have described the inner surface of her stomach as raw with red pimples, and perceived a little pouch full of blood! The Baron is now publishing a work upon mesmerism in London.

For a complete history, see the *Diction. des Sc. Méd.* article *Magnétisme Animal.* The writer remarks that, in some Egyptian monuments, Anubis is represented near the patient as a mesmeriser, with one hand raised above the head, the other on the breast, while behind the patient another figure stands with the right hand elevated. See also the work of Deleuze, 2 vols.; the Marquis de Puisegur, 3 vols.; the Count de Puisegur, 4 vols.; Chardel, 1 vol.; Tardi de Montravet, 2 vols.; the *Bibliothéque du Magnétisme,* 4 vols.; *Archives du M.,* 4 vols.; *Annalen des M.,* 4 vols. Dr. Bertrand's excellent treatise *Du Magnétisme Animal, &c.,* 2 vols. Paris, 1826. He at first ascribed all to imagination; but was obliged at last to admit an unknown power. The reader of English only should consult *Isis revelata,* a work just published in two volumes, by Mr. Colquhoun of Edinburgh. It contains great information, and is highly amusing, not the less so perhaps for containing some nonsense.

wonderful for belief. I must be excused for not believing, till I have seen these things. Those who have read the history, and seen a little, of human nature, well know what deceptions have been practised upon the most wary; how long it has been impossible to detect the cheat; how bold and marvellous have been the impositions; and yet that at last the truth has come out, the impostor been covered with shame and the credulous believer with ridicule. Human testimony has been given to all kinds of absurdities and impossibilities in all ages, and may always be obtained from ignorance, superstition, enthusiasm, or interest, to any amount for any prodigy. It may be sometimes difficult to say what is contrary to the laws of nature and impossible; but the wonders of mesmerism are so astounding, and our experience of deception so abundant, that I find it more rational to suspend my belief than to admit them. Indeed, the most zealous mesmeriser must allow that deception on the part of the patient has frequently been detected; that women have appeared to be in so deep a mesmeric sopor that they have borne impressions of melted wax without the least agitation of countenance, and yet the whole has been proved an imposture: nay, that collusion between both parties has been discovered. We have seen that the same prodigies have been recounted as occurring in ordinary ecstacy and somnambulism as from mesmerism.

No one will allege that deception must have been impracticable, who knows the tricks performed by Asiatic and African jugglers[g]: and no one will allege that frequently no motive for deception was possible, who remembers that, besides interest, and even against interest and comfort, the desire to excite attention in ill conducted minds, and to excite attention or even simply to deceive in hysterical disease, is often intense; and no one will

[g] They will not only make a branch blossom before your eyes, but a seed spring up into a tree, and the tree bear fruit; throw one end of a long chain into the air, where it remains as if fixed, and send a dog up it, which disappears as soon as he has reached the other end: they will take the form of a cube, which then rises into the air, remains stationary over the heads of the spectators, and descends again; sit in the air four feet from the ground, one hand and arm being held up, the outer edge of the other resting on a crutch, while its fingers deliberately count beads; and will cause unblemished boys or women, or pregnant women, to see in ink the figure of any dead or absent individual that a third person may name. See Mr. Hunter, l. c. p. 284. sqq.; and Mr. Lane's recent work on Egypt.

urge the sense, attainments, and respectability of the believers, who has seen much of human nature, for he must know that the wisest have their weak points, and especially in regard to extraordinary things, which they often gloat upon like the most ignorant peasant, and that many who pass for highly informed men possess but partial information, and many who are distinguished for some one kind of discovery and pass for men of talent, possess but a moderate share of high and general intellectual power. The chief British advocate of all the miracles of mesmerism believes a thing to have been possible, which was an evident trick, and in which interest was the palpable and only motive. A Scotchman exhibited a boy lately in London, whom he pretended to be gifted with second sight. I went to the exhibition, and the boy told the colour and other qualities of things without seeing them, the names and ages of strangers in the room, &c. &c. But the father very fairly demanded that we should show him the objects, and tell him our names and ages, in short, make him acquainted with the facts, previously, in order that we might not say the boy was wrong when he was right. The boy, on being admitted into the room, without previous conversation with any person in it, invariably gave correct answers. A friend who accompanied me at once pointed out the trick. The father always addressed the boy before the little fellow uttered a word: and he began each successive sentence with a word, the first letter of which went to form the answer. For instance, if the object was of SILK, the father might begin — "*S*ee now you answer correctly; *I* know you will; *L*ook well before you speak; *K*now what you are about." Or each letter of a word of ten letters might be agreed upon, each being different, to signify a particular number. Thus if the letters of the word Cumberland were settled to signify 1, 2, 3, &c. in the order in which they stood, the father would begin, after a numerical question, with a sentence, the first letter of the first word of which signified the first number; then next with a sentence beginning with the letter signifying the second number. This was the principle, and of course there might be many variations of its application.[h] Mr. Colquhoun records, that "the father

[h] My friend's explanation will be given in a new edition of Dr. Brewster's *Letters on Natural Magic*, in which numerous deceptions are explained. A more copious work is by Eusèbe Salvert. *Sur la Magie.*

stated he had five children, all gifted in the same extraordinary way:" and, though Mr. C. acknowledges there is much room for deception, "*would strongly recommend*" (in italics) the investigation of the facts to professional men, because he has "sufficiently proved that the phenomena exhibited are of possible occurrence."[i] He would have us believe the case of Miss Macaray, of Liverpool, a Roman Catholic young lady, who became blind in June, 1816, when fifteen years of age, and accidentally discovered in the following October that she could read with her fingers the "Lives of the Saints,"—the "Life of Thomas à Becket," and the Bible; having previously, after having become totally blind, presented a stole made by herself to her confessor. Whether the priest, for the glory of God and the church, suggested subsequent miracles of sight to her, or she imposed upon his Roman Catholic credulity, is a matter of speculation. She told an object placed under two plates of glass, by touching the upper plate of glass with her fingers; and could read with her fingers nine inches from the book, *by a convex lens which she touched!* Now this single circumstance proved the whole to be an impudent imposture. If the lens could have assisted her fingers to see, it must have been when they were placed at that particular distance from it at which the rays formed an image of the object; not when they were in contact with it. At its surface, a lens affords no image of an object: yet to her fingers, touching the surface of the lens, objects appeared magnified if the glass was convex, small if it was concave! This statement was a most unlucky mistake; she should have pretended to see with her fingers at the proper focal distance.[k]

Voltaire advises the Devil never to address himself to the faculty of physic, but to that of theology, when he wishes to impose upon mankind. However, in 1726, a poor woman at Godalming in Surrey, named Mary Tofts, pretended that, after a violent longing for rabbits, when pregnant, she brought forth these animals; and persuaded her apothecary, "Mr. Howard, a

[i] l. c. vol. ii. p. 339. sq.

[k] See *Annals of Med. and Surgery;* London, 1818, vol. ii. p. 385.; where it is remarked as singular that no person thought of ascertaining whether the point which she touched upon the glass was in a line between the object and her eyes; and whether an intervening opake substance, placed in this line, prevented her power of discriminating objects.

man of probity who had practised for thirty years," or, in common language, a highly respectable practitioner of great experience, that, in the course of about a month, he had delivered her of nearly twenty rabbits. George the First, not thinking it impossible, sent his house surgeon, Mr. Ahlers, to inquire into the fact; and the royal house surgeon returned to London, "convinced that he had obtained *ocular* and *tangible* proof of the truth," and promised to procure the woman a pension. The wise king then sent his sergeant-surgeon, Mr. St. André: and the sergeant-surgeon returned to town also a firm believer. They both returned with rabbits as *proofs!* and the rabbits had the high honour of being dissected before the king. An elaborate *Report* of their production and dissection was published by the sergeant-surgeon; and Whiston (of the faculty of theology indeed) showed, in a pamphlet (for a furious controversy arose between the believers and the unbelievers), that the miracle was the exact fulfilment of a prophecy in Esdras. An eminent physician, Sir Richard Manningham, backed by Caroline, then Princess of Wales, detected the cheat, and, on a threat of a dangerous operation and imprisonment, Mary Tofts confessed the whole. — Ann Moore of Tutbury, of extreme piety, and with a Bible always on her bed before her, pretended in 1808, sqq. to have taken nothing into her mouth for six years but the inside of some black currants once; and for the last four years and a half, nothing. There was no peculiar state of the nervous system to account for the circumstance. She was watched for sixteen days and nights in September, 1808: and members of the faculty of theology and medical practitioners testified to the truth of her statement: though Dr. Henderson showed, from many circumstances, to all rational people, that it was an absurd imposture. The Rev. Legh Richmond, in 1813, earnestly solicited her to undergo another watching. She consented; and, having caught a bad cold and thinking herself dying, she with great solemnity said, "In the face of Almighty God, and on my dying bed, I declare that I have used no deception," &c. Yet evidence of guilt and falsehood was at last obtained, attempts at concealment were useless, and she publicly expressed her contrition for her long continued imposture.[1]

[1] See an interesting work by my friend Mr. Hunter; *Sketches of Imposture, Deception, and Credulity,* — *Family Library.* London, 1737.

Gall was at considerable pains to examine into the facts of mesmerism. It was then in high favour with many, and adopted by many physiologists in their writings, so that he felt "the subject as delicate as it formerly was to proceed against sorcerers."[m] To avoid the charge of misrepresentation, he quotes the words of Kessler, who maintains that the epigastrium of the magnetised can perform the functions of all the five senses, and more acutely too than the special organs under ordinary circumstances; the fingers read the smallest print; the contact of the magnetiser's thumb render the ears unnecessary for hearing,—"the most common fact in the world, and the simplest experiment;" and complete vision take place with the eyes shut, so that all obstacles are avoided as dexterously in strange as in familiar places. "I will not bring a multitude of proofs, and the authentic testimony of many credible persons,' says Kessler, "but will mention only what I have seen again and again, and of the truth of which any one may satisfy himself favourably by his own experience."[n] Gall then, at great length, quotes Walther, the professor at Landshut, for a description of the stages of mesmerism, in the highest of which (*clairvoyance*) "time and space no longer present obstacles to the penetration of the magnetised," "who sees as distinctly into the interior of the magnetiser's body as into his own," the reason of which is, that "all the nervous system is an identity and a totality — a pure transparence without cloud, an infinite expansion without bounds or obstacles, — such is universal sense;" and, as "in the waking state the soul is more closely and intimately united with the body," and "natural sleep is a more intimate communication of our soul with the universal soul of the world; so in magnetic sleep our soul is united in the most intimate manner with the soul of the world and with the body, and with the latter not by means of the nervous system only, but immediately in all its parts and members, so that life is no longer a particularity, but original life."[o] "If any one," says Gall, "is convinced of all these marvellous fancies, and especially if he comprehends them, he is justified in asserting that such a doctrine exercises the most important influence upon the whole science of nature." Reil, so strangely brought forward as the rival of Gall,

[m] l. c. 4to. vol. i. p. 135. sqq.

[n] *Prüfung des Gallschen Systems.* Jena, 1805.

[o] *Phys.* t. ii. p. 244.

is the third whom he quotes: — "The estimable Reil," thus Gall generously terms him, "after having spoken of the abdominal ganglia as capable of becoming the conductors of sensation, says, 'the transition to the state of a conductor is so much more easy in living than in inanimate nature, that a communication may be established between the magnetiser and the magnetised, so that if the former chew pepper, the latter tastes it;'" "the magnetised are enabled to know by this evidence the configuration of their interior just as well as if they saw it with their external senses;" "a patient described the thoracic and abdominal viscera, the spinal marrow, the sympathetic nerve, and the solar plexus, as white threads and clear spots; some have heard sounds too low to be heard by others; some, with their eyes shut, have perceived objects, and especially men, in another apartment, and foretold, without ever making a mistake, what persons would come to the house: the magnetiser scratches himself, the magnetised itches at the same part; the former coughs, pricks himself, the latter also coughs and feels the prick[p]: the magnetiser takes wine and pepper into his mouth,

[p] This equals Sir Kenelme Digby, who solemnly assures us that a gentleman, having had his hand wounded in a duel and suffering great pain, found the pain suddenly cease when Sir Kenelme dissolved some powder of vitriol in water, and put into the solution the *bloody* garter with which the wound had been bound up. A few hours afterwards, however, he took the garter out of the solution and dried it before a large fire; but "it was scarce dry before the wounded gentleman's servant came roaring that his master felt as much burning as ever he had done, if not more, for the heat was such as if his hand were twixt coales of fire." He desired the man to return home, saying, "his master should be free from that inflammation, it may be, before he could possibly return unto him."—"Thereupon he went, and at the instant Sir Kenelme did put again the garter into the water: thereupon he found his master without any pain at all. To be brief, there was no sense of pain afterwards, but within five or six dayes the wounds were cicatrised and entirely healed." (*A Late Discourse made in a Solemne Assembly of Nobles and Learned Men at Montpellier in France,* by Sir Kenelme Digby, Knight, &c.; rendered faithfully out of French into English, by M. White, Gent., ed. 2. London, 1658. p. 6. sqq.) I may mention that the knight anticipated another folly and imposition, just as it may be with different practitioners, — Hahnemannism, or homœopathy, by pointing out an undoubted remedy on the principle of *similia similibus.* "Tis an ordinary remedy, though a nasty one, that they who have ill breaths, hold their mouths open at the mouth of a privy, as long as they can, and by the reiteration of this remedy they find themselves cured at last." p. 76.

and both taste them: the magnetised distinguishes magnetised from common water, foretells the commencement and duration of the paroxysm of his diseases, and points out the remedies." [q]

Gall, with that beautiful and playful irony which so characterised him, and with which he delighted to annihilate his adversaries' absurdities, after remarking that the human mind always turns in the same circle, — that Plato and Socrates had taught that our souls knew every thing originally, were in intimate communication with the universal soul of the world, and that their connection with the body did but impede the free use of their knowledge, avows that, if, in mesmeric sleep, our soul becomes intimately united with the soul of the world, none of the incredible tales of mesmerism can be doubted. "It is a trifle to hear a poor peasant, born far from Upper Saxony, speak the dialect of that country in its purity and with all its inflexions, and possess the gift of *unknown* tongues: to see another stupid peasant, ignorant of French, read correctly and understand a French book applied to her stomach. To read with the fingers, to know the hour by the watch in my pocket, to see through walls and houses, and perceive at a distance a person who will come to the house, are all wonders explicable by the intimate connection with the universal soul of the world. We thus see that if ever a great truth was promulgated, it is the doctrine of predestination and pre-established harmony. Magnetism proves, in the most peremptory manner, that every thing in the universe is not only concatenated, but completed. The dialect of Upper Saxony, the French language, my watch, the visit of the stranger, the letter of a lover which you fancy is so snugly concealed in your bosom, are concatenations of the world as necessary as the sun is to the universe. Say, now, what can be concealed from us either present or future?"— "We will not ask how the soul can be united intimately with the body and with the soul of this world at the same time; how it can be confined in its narrow prison and at the same moment detached from all its ties; how the soul of the magnetiser and the magnetised can be mingled, and afterwards separated again." "Unfortunately," he continues, "scientific discoveries still have to be made by the long and laborious method of experience, notwithstanding the magnetised

[q] *Archiv. für Physiol.* b. vii. st. 2. s. 232.

see all their internal structure in the clearest manner, and magnetism has been practised so long."

The result of Gall's investigation was this:—"Neither we, nor any other dispassionate observers, who have been present at the famous experiments of which such wonderful accounts have been given, have witnessed any thing supernatural or contrary to nature: we ought therefore to abandon the belief of the metamorphosis of nerves (the performance of the function of one nerve by another) to those who are better organised for the marvellous than ourselves."

It being, however, impossible to deny such facts of mesmerism as occur in some nervous diseases, are they to be ascribed to mere imagination — an excitement of the feelings by the gesticulations and proximity of the manipulator [r], or to the operation of an unknown power? Gall admits this power, and even does not reject the hypothesis of its connection with a fluid. "How often in intoxication, hysterical and hypochondriacal attacks, convulsions, fever, insanity, under violent emotions, after long fasting, through the effect of such poisons as opium, hemlock, belladonna, are we not in some measure transformed into perfectly different beings, for instance, into poets, actors, &c.?"—"Just as in dreaming, the thoughts frequently have more delicacy, and the sensations are more acute, and we can hear and

[r] "Among all the phenomena, however," says Professor Dugald Stewart, "to which the subject of imitation has led our attention, none are, perhaps, so wonderful as those which have been recently brought to light, in consequence of the philosophical inquiries occasioned by the medical pretensions of Mesmer and his associates. That these pretensions involved much of ignorance, or of imposture, or both, in their author, has, I think, been fully demonstrated in the very able report of the French academicians; but does it follow from this that the *facts* witnessed and authenticated by those academicians should share in the disgrace incurred by the empirics who disguised or misrepresented them? For my own part, it appears to me, that the general conclusions established by Mesmer's practice, with respect to the physical effects of the principle of imagination (more particularly in cases where they co-operated together) are incomparably more curious than if he had actually demonstrated the existence of his boasted science: nor can I see any good reason why a physician, who admits the efficacy of the *moral* agents employed by Mesmer, should, in the exercise of his profession, scruple to copy whatever processes are necessary for subjecting them to his command, any more than that he should hesitate about employing a new physical agent, such as electricity or galvanism." *Elem. of the Phil. of the Human Mind*, vol. iii. p. 221.

answer: just as in ordinary somnambulism we can rise, walk, see with our eyes open, touch with the hands, &c.; so we allow that similar phenomena may take place in artificial somnambulism, and even in a higher degree."—"We acknowledge a fluid which has an especial affinity with the nervous system, which can emanate from an individual, pass into another, and accumulate, in virtue of particular affinities, more in certain parts than in others."—"We admit the existence of a fluid, the subtraction of which lessens, and the accumulation augments, the power of the nerves; which places one part of the nervous system in repose, and heightens the activity of another; which, therefore, may produce an artificial somnambulism."[s]

A rigid mathematician, La Place, observes that, "of all the instruments which we can employ, in order to enable us to discover the imperceptible agents of nature, the nerves are the most sensible, especially when their sensibility is exalted by particular

[s] It may be interesting to mention an observation which Gall made upon himself by chance, and which, independently of the phenomena of mesmerism, confirmed him in this opinion. Having, while in contemplation, placed his hand upon his forehead, and walking backwards and forwards several times with his fingers over the hairy part of the front of his head, at about the distance of an inch, he remarked a gentle warmth, like a vapour, between his hand and the upper part of his cranium: he felt a heat ascend towards his shoulder and cheeks: heat in the head and chilliness in his loins. The same thing having recurred several times arrested his attention, and he repeated the experiment, and always with the same results. If he continued to move for some moments, with his hand suspended, the same phenomena increased. "The eyes become painful, and tears run down; the tongue can no longer articulate, twitchings of the face occur, respiration grows laborious, and sighing and oppression follow; the knees tremble, and totter: and some hours of repose are required to restore him perfectly.

"He has often, by the continued movement of the hand, produced similar phenomena in persons not previously aware of them. He produced even deep and prolonged fainting: he has, in regard to this peculiarity, a particular affinity with persons of both sexes who have fine and rather curly hair. They only act upon him in this manner, and he is able to distinguish, by this singular impression, if it is an individual of this description or not, who, at a fixed distance, in a numerous company, moves his hand over the superior anterior part of his cranium. On the other hand, he can act upon persons of this constitution only. The rapidity with which he loses his senses, and especially the extremely disagreeable impression produced by an inexplicable depression, have prevented him from pushing the trial beyond this and obtaining farther results."

causes. It is by means of them that we have discovered the slight electricity which is developed by the contact of two heterogeneous metals. The singular phenomena which result from the extreme sensibility of the nerves in particular individuals have given birth to various opinions relative to the existence of a new agent, which has been denominated animal magnetism, to the action of the common magnetism, to the influence of the sun and moon in some nervous affections, and, lastly, to the impressions which may be experienced from the proximity of the metals, or of a running water. It is natural to suppose that the action of these causes is very feeble, and that it may be easily disturbed by accidental circumstances; but, because, in some cases, it has not been manifested at all, we are not to conclude it has no existence. We are so far from being acquainted with all the agents of nature, and their different modes of action, that it would be quite unphilosophical to deny the existence of the phenomena, merely because they are inexplicable in the present state of our knowledge."[t]

Cuvier fully admits mesmerism: — "We must confess that it is very difficult, in the experiments which have for their object the action which the nervous system of two different individuals can exercise one upon another, to distinguish the effect of the imagination of the individual, upon whom the experiment is tried, from the physical result produced by the person who acts for him. The effects, however, on persons ignorant of the agency, and upon individuals whom the operation itself has deprived of consciousness, and those which animals present, do not permit us to doubt that the proximity of two animated bodies in certain positions, combined with certain movements, have a real effect, independently of all participation of the fancy. It appears also clearly that these effects arise from some nervous communication which is established between their nervous systems."[u]

I have no hesitation in declaring my conviction that the facts of mesmerism which I admit, because they are not contrary to established morbid phenomena, result from a specific power. Even they are sometimes unreal and feigned, and, when real, are sometimes the result of emotion, — of imagination, to

[t] *Théorie Analytique du Calcul des Probabilités.*

[u] *Anatomie Comparée*, t. ii.

use common language; but, that they may be real and independent of all imagination, I have seen quite sufficient to convince me.

In May, 1829, I was introduced to Mr. Chenevix by Dr. Hodgkin, and, as that gentleman had persuaded himself, theoretically and practically, at Paris, of the truth of mesmerism, I seized this opportunity of commencing an experimental examination, by availing myself of his offer to mesmerise any person I might present to him. I saw him mesmerise two girls at his own lodgings in Old Burlington Street, and took him several times to St. Thomas's Hospital. The two girls appeared to fall fast asleep by the process: but, though I watched them very carefully, I might be deceived, and, as they were well known to Mr. Chenevix, and had been mesmerised before, I drew no inference. At St. Thomas's Hospital, I selected female patients at random from my list of their names, and neither he had seen them nor they heard of him or mesmerism. Each was manipulated alone in a private room. On manipulating a patient of a colleague, who selected her himself, she had an hysterical fit, at which I was not surprised, as hysteria was her complaint and the least emotion at any time excited a paroxysm. He endeavoured to put an end to it in vain. On a second occasion, a violent fit recurred and his attempts to calm it were fruitless. He manipulated six other young females, with no effect, except that one, labouring under chorea, said her head was light and heavy alternately, and menstruated two days afterwards for the first time during three months. An epileptic woman fell asleep, apparently, on the two occasions she was mesmerised: yet we found that she was not asleep the second time, and she declared she had not been asleep the first time, though on both occasions she felt drowsy. I did not venture to conclude she was asleep, but the redness of her eyes and cheeks, the heaviness of her look, and every circumstance make me now believe she was asleep the first time, for I have seen many mesmerised persons fast asleep, who afterwards denied it. Pain was produced in her arm, and afterwards in her head, and presently recurred by manipulating in another direction; from this I inferred nothing then, but I have since then witnessed such phenomena so frequently, that I do not doubt their reality and their production by the manipulator. I remained unconvinced

till another female was mesmerised. She was an ignorant Irish girl, and unprepared to expect any thing. In a minute she plaintively entreated Mr. Chenevix not to proceed. The manipulations "drew weakness into her, and made her feel faint." She next complained of pain in the abdomen; on a few transverse movements she said the pain was gone: the same thing occurred several times, and once pain was complained of in the chest, but ceased perfectly after a few transverse movements. He darted an open hand towards one of her arms, and told her to raise it; she could scarcely move it: after a few transverse movements, she declared the stiffness and uneasiness were gone, and she moved it as well as the other. He produced all the same effects on the other arm, and then upon one leg. Her eyes were closed as perfectly as could be, and, a piece of paper weighing, perhaps, a grain, being placed upon one foot, she instantly was unable to raise it; the paper was removed, and she raised it directly. All these things were repeated again and again, I telling Mr. Chenevix, in French, which part I wished to be rendered powerless and which to be restored and she being prevented as much as possible from seeing. "Deception was impossible. Mr. C. looked round at me, and asked, in French, if I was satisfied. I really felt ashamed to say no; and yet I could scarcely credit my senses enough to say yes. I remained silent. He then asked me, still in a language unintelligible to the patient, 'shall I bring back a pain, or disable a limb for you once more.' I of course requested that he would do so. He complied instantly, giving her a pain in the chest once, and disabling her several times from moving her limbs, and removing those effects at pleasure, according to the intentions he avowed to me; the whole taking place exactly as it had done in my former trial with this woman." [x]

From this time I was satisfied that such a power as mesmerism exists, and hoped some day to inquire into it. I had no opportunity, however, before the arrival of Baron Dupotet in this

[x] I allowed Mr. Chenevix to publish my memoranda of what I saw. They will be found in the *London Medical and Physiol. Journ.* for Oct. 1829, which contains the last of a series of papers by him on mesmerism. He did not print them with perfect fairness, but omitted two or three comments, and I think facts, unfavourable to mesmerism, in regard to those cases in which the effects were none or doubtful.

country a few months back. As mesmerism is extolled in nervous diseases, I selected three epileptic patients, a male and two females, at University College Hospital, in whose disease I despaired of doing any good: and one hysterical female, who was said to have fits at such very distant intervals that I really could not tell whether she had any thing the matter with her, and who would not have been allowed to remain in the Institution. Several students and other gentlemen and myself submitted to the manipulations. On some gentlemen no effect was produced, but the process was not repeated above once or at all in them: of the greater number, some experienced a tingling or some strange sensation in the arms, legs, or face, frequently with little twitchings, an oppression and unusual heaving of the chest in respiration: and some always felt a heaviness or unusual sensation about the forehead, and even drowsiness, convincing them that they were under some strange influence, and on repetition experienced nothing more; I was mesmerised frequently, and always but once with the effect of tingling and twitchings only. Those who had never heard of tingling and twitching being the result, but conceived they were to be sent to sleep, experienced these effects abundantly; and many, who sat down laughing at the whole as nonsense, honestly confessed they were affected by some influence. Some of these had witnessed the soporific power of the process, and believed in mesmerism, like myself, and yet none could be sent to sleep. A visiter one day was put to sleep, but he never returned, and I did not see him. The four patients were sent fast asleep, the man always, and in from five to ten minutes; occasionally in longer time, occasionally in less. One of the epileptic females was manipulated very often before she slept, although she was delighted at the process and mortified whenever she was not subjected to it with the others. At length, however, she began to sleep under it; and once was sent to sleep in a few moments; but the process often failed with her. The other was for a great length of time sent to sleep invariably; but a curious circumstance at length occurred,—a few moments after she had lost herself in sleep she awoke, and it was impossible to give her longer sleep than for a few moments. This always happened repeatedly during the process, till Baron Dupotet was too tired to continue it: and it happened in every process for a long while.

At length, however, she was put to sleep again for the same time as before. The patients, when about to sleep, either showed a fixed stare, or they looked heavy and their eyelids gradually dropped or winked; their breathing became heavy; and sometimes they changed from waking to sleeping in an instant. When they were asleep, the head nodded or fell in one direction or another, the arms fell, they breathed loud or even snored. In some, twitchings of the fingers, feet, arms, legs, or face took place: in the hysterical girl the eyeballs rolled rapidly from side to side, or the lower lip was raised and depressed. These movements were the more striking that they alternated. On awaking, she never could open her eyes; but, on the Baron's making a few transverse passes above and below them, she opened them instantly. This invariably occurred: I and others every day made the same passes in vain. If we raised her eyelids, they instantly fell. We begged her to open them; but, till the fingers of him who had mesmerised her made transverse movements, they remained closed, however long we waited. In the rest, the sleep lasted a short time only: from a few minutes to a quarter of an hour: but in her it was very protracted; it was often so profound that she did not feel pricking nor pinching; and it seldom ceased till put an end to. This the Baron always did instantly at our desire, by transverse movements; when she got up, rubbing her eyes and looking drowsy for a minute, and then walked away as if nothing had occurred. The man often on awaking complained of a pain in some part or other, or some very strange sensation, which was immediately dissipated by transverse movements. At first he liked the process and prepared the chair with delight: but, after a time, he took a dislike to it, and at length requested not to be mesmerised, but to trust to medicines for his cure, and I of course did not oppose his wishes. Yet at both periods the effects were precisely the same upon him.

One of the students tried the process upon an epileptic girl, a patient of the gentleman with whom he lived at the distance of several miles from the College, and sent her presently off to sleep for several hours. He offered to bring her to the Hospital, as she was so susceptible of mesmeric influence; and she came three times a week. Her eyelids were always closed presently: and she never could open them till the Baron made transverse passes around them. I always attempted, but in

vain; and, if I opened them forcibly, they immediately shut again. After the Baron had done this, she always was sent asleep rapidly; and it was invariably remarked that at length she made one deep inspiration, and was then in a comatose sleep. This deep inspiration, the Baron informed me, is the uniform precursor of the coma. From this moment, we could do what we pleased without waking her,—halloo in her ears, dash her arms in any direction, pull her hair out, pinch her hand, put snuff up her nose: she was perfectly insensible, breathing placidly, and slept on in spite of any attempt to awake her, till the Baron made two or three transverse movements, when she instantly awoke. These phenomena were too striking and invariable for any rational person to disbelieve that some peculiar power had been in operation. Still, though awake, she generally could not open her eyes till transverse passes had been made around them. Her lower jaw was always firmly closed in her sleep, so that none of us could open it: but the Baron always caused it presently to open on moving his finger along it or holding his hand in contact with it: it was opened more slowly by manipulations made without touching her. On one occasion he held his finger near the meatus of the ear, and she presently heard, and from that time heard more or less and talked, especially if he operated again upon the ear; but after she was awakened she knew nothing that had passed in her sleep-waking. Still she was mesmerised many times before she answered questions: she heard a noise, and this roused her sufficiently to make her talk of what was present in her mind, but her words had no relation to the question. At length she began to speak to every question; and, on one occasion, on being teased again and again to give an answer when she repeatedly declared she could not, she fell into a violent rage, rose, seized the inquirer, shook and pushed him with both hands, and on being forced into a chair, after resting quiet a few minutes, she rose and made at the same person again very fiercely, and, sat down at last with difficulty, pale with rage, and her hands quite cold. Baron Dupotet thought it right to awaken her, and did so immediately, when she smiled with her natural good humour, and, on being addressed, proved herself to be in complete ignorance of all that had just passed.

The power of mesmerism was shown as strikingly though differently upon one of my two epileptic female patients. She ceased

to have epilepsy; but fell into fits of ecstacy, which I described at p. 629., perfectly insensible, though with her eyes open, chattering, mimicking, relating stories, &c. This state could be put an end to by mesmerising her. Generally she was restored in less than a quarter of an hour, even after this state had continued many hours, or even for a day or a week; once or twice it resisted long manipulations, but they continued, excepting once, till put an end to by the process, and that once, I understood, she fell back very soon into the state again. These attacks, I have already said, changed to ecstatic delirium; in the fits of which she was in possession of all her external senses, and these attacks were terminated by mesmerism, just like those of simple ecstacy or sleep-waking. They ended with momentary sleep. While sitting before the magnetiser, looking attentively at him, and saying all sorts of ridiculous and witty spiteful things, pale, with the countenance of a maniac, she suddenly seemed lost, her eyes rapidly closed for a moment, then opened, she looked astonished, and was in her perfect senses, smiling amiably, behaving in the most proper manner, in short, in full possession of her intellect and feelings. This phenomenon was, if possible, more striking than the sudden awaking of those who were in a state of coma. It occurred again and again and again for weeks, and the young gentleman under whose care the patient was in my absence from the hospital, succeeded like Baron Dupotet in bringing her to herself, and even two or three times when the latter had not been able through the state of exhaustion in which he was from having magnetised very often and long in the course of the day.

These are the phenomena which I have witnessed. To ascribe them to emotion and fancy, to suppose collusion and deception, would be absurd. They must be ascribed to a peculiar power; to a power acting, I have no doubt, constantly in all living things, vegetable and animal, but shown in a peculiar manner by the processes of mesmerism. I have witnessed its power at least three times a week for two months: and should despise myself if I hesitated to declare my decided conviction of the truth of mesmerism. I am willing to believe that a sleep-waker may prophesy morbid changes in himself with accuracy, as the boy mentioned by Gall predicted the termination of his fit if his friends would lead him into the garden, and the girl mentioned by Lord Monboddo predicted the cessation of her disease with

equal accuracy. I cannot forget that a minute portion of semen masculinum, probably far less than a drop, will transmit a father's structure, mental and bodily character, in the minutest points, even idiosyncracies of affection from various articles of food and medicine, and from morbid influences, so that the offspring may never take a particular contagious disease or not take it till a certain time of life, just like the father.

This declaration will excite a smile with almost every body; for, since the report of the French commissioners in 1784, it has been customary to ascribe all mesmeric phenomena to imagination or deception. But I set no more value upon reports of French commissioners than the reports are worth. I know their reports on Gall's labours (see *suprà*, p. 329. sq.), contradicted by themselves in their subsequent report on M. Fleuren's experiments; on Le Gallois' experiments, so well opposed by Dr. W. Phillip; their injustice to Dr. Tiedemann; and afterwards to Dr. Vimont. I have never yet declared an opinion upon a new truth that I have been obliged to retract. Phrenology has now advanced to its firm establishment; Human Glanders is universally admitted; Auscultation is invariably practised except by the wretchedly ignorant: Quinine, Prussic acid, Creosote, are now in daily use. I stood abundant ridicule for advocating these, and will now stand more ridicule with the same firmness and the same silent pity [y] or contempt which I have always felt for my opponents, till I see, as I shall, the truth of mesmerism also admitted and the world forget that it was ever doubted. Ignorance and party feeling are more unblushing when many are united officially, than when all is left to private and individual discussion. For expressing opinions favourable to mesmerism, two French academicians were expelled, and Mr. Chenevix I heard censured after his death as a fellow of the Royal Society by the President from the chair. The first French commissioners strangely referred all the effects which they witnessed to imagination, imitation, and touching. Now the influence of touching must have been different from that of imagination, as they employed two distinct words, and therefore all could not have been imagination even in their view. Franklin was so

[y] "Rideat me ista dicentem, qui non intelligit; et ego *doleam ridentem me;*" said St. Austin. *Isis revel.* vol. i. p. 81.

generally absent and paid so little attention that he ought not to have signed the report, and seems to have taken the absurdity of the thing for granted. The celebrated Jussieu refused to sign it, and made a special report of his own.[z] I have seen so much of what is wrong, in bodies and in individuals, that the opinions of the former and of the latter, whatever may be the rank, title, office, power, riches, or scientific character of the parties, never are regarded by me beyond their own simple worth.

But I have never witnessed more than what, it is certain, takes place in health and disease. I have seen persons sent to sleep, I have felt and heard others declare they had tingling, and heard some declare they had various other sensations and pains, I have seen twitchings, convulsions, and spastic contractions of muscles, loss of power of muscle, and the most profound coma; and I have seen these evidently and instantly removed by the process. I have seen one sense restored in the coma by the process, so that the person was insensible in taste, smell, sight, and yet heard and answered questions well. I have seen paroxysms of sleep-waking and ecstatic delirium, which had been originally induced by its disturbance of a system already epileptic, put an end to evidently, and in general quickly, by mesmerism. But I have not witnessed persons seeing through walls or pasteboard, nor tasting or smelling with the epigastrium or fingers; nor speaking or understanding languages they had never learnt; nor telling the circumstances past, present, and to come of persons they had never heard of before. Yet I have persevered with patience and docility. Often have I seen Baron Dupotet speak at the epigastrium and finger ends of the ecstatic and comatose patients: often heard him address them in a language with which they were unacquainted: often ask when they would have another fit; but nothing, which, till I witness such things, I must consider supernatural, has yet occurred. He has frequently said that these phenomena would soon occur, — that the patients would probably soon become *clairvoyans:* but no. No marvel has yet presented itself in my experience: nor has any good been yet effected in the diseases of my patients; but the perfect coma induced in some of

[z] *Rapport de l'un des Commissaires, A. L. Jussieu, chargés par le Roi de l'Examen du Magnétisme Animal.* Paris, 1784.

them would be an inestimable blessing in the case of a surgical operation, which I am positive might have been performed without the slightest sensation on some of the female patients, exactly as took place at the Hôtel-Dieu, where a cancerous breast was removed in mesmeric coma from a poor woman without her knowledge. I have no doubt that I shall in time see all the established phenomena of sleep-waking, — writing, reading, and doing endless things even better than in the waking state. But, before I see, I cannot believe more. I cannot believe that even those strange phenomena are produced by it which some declare to occur occasionally in plain sleep-waking, because I must see such sleep-waking before I believe it. Yet I will continue a little longer with docility to inquire and learn, for of Baron Dupotet's perfect good faith I entertain no doubt, however credulous he may be.

The observations of the late French commission agree with mine; but they go farther. Sometimes there was no effect; sometimes but slight effects; sometimes decided effects, as sleep, extreme insensibility, and muscular movements on the direction of the fingers of the mesmeriser, though sometimes none, and sometimes with scarcely uniformity enough for any one to assert that the movements resulted from it; sometimes insensibility of a particular sense dissipated, so that perfect coma was exchanged for sleep-waking, or the whole coma dissipated at the pleasure of the mesmeriser by transverse movements.

They saw a large variety of the more wonderful, but established phenomena of sleep-waking, such as appeared in many of the cases, related by me, unconnected with mesmerism: but which the shortness of time only has prevented me from witnessing. They, however, believed that they witnessed more than this. They declare they witnessed the production of sleep-waking by mesmerism practised in the next room to that in which the patient was; that they witnessed *clairvoyance*, — reading and perfect recognition of objects of sight, &c. amounting to the ability of playing games of cards, &c. in coma, with the eyes completely closed; accurate prophesying of the day of occurrence of distant epileptic attacks and of other events of the case; great diminution of epilepsy; rapid cure of hemiplegia; true declarations of the seat and nature of the diseases of strangers

by mesmerised persons in the state of sleep-waking who had never seen them before, but who were placed in relation with the patients by putting their hands in contact with them. The details are most interesting, and, in at least all particulars to which my own experience extends, I have no doubt most faithful. The report is signed by MM. Bourdois de le Motte, Fouquier, Gueneau de Mussy, Guersent, Husson, Itard, J. J. Leroux, Marc, and Thillaye.

After translating this report, Mr. Colquhoun refers to some cases of mesmeric sleep-waking in which it is said that the surface of the body acquired a new power of sensation; some related by M. Tardy de Montravel[a] of the recognition of objects of sight by the epigastrium even at some distance; one by Dr. Gmelin[b]; one of a Scotchman named Macgill, a servant of a Russian ambassador, who resolved the man's cure should be attempted by mesmerism, and describes all the phenomena himself[c]; one of an epileptic boy at Jena, magnetised by Professor Kieser[d], with the effect of producing various nervous symptoms, coma, convulsions, chorea, tetanus, and at length perfect sleep-waking, in which, though the eye appeared quite blind, objects of sight were recognised by his toes, fingers, elbows, shoulders, abdominal and facial surface, chin, and point of the nose. Similar cases without end are recorded in works on mesmerism.[e]

[a] *Traitement Magnétique de la Dem. N.* vol. i.

[b] *Material für die Anthrop.* vol. ii.

[c] *Biblioth. du Magn. Animal*, vol. iii. p. 126.

[d] *Archiv fur den thierischen Magnetismus*, vol. iii. No. 2.

[e] The work of Mr. Colquhoun is meritorious in a literary point of view — for the industry and ardour employed in it, and for the total disregard of the laughter of the ignorant and prejudiced world at large, and of the contempt of men who, eminent in one department of science, consider themselves authorities in matters which they have never studied. It is valuable also for the translation of the French Report, which had never been published and was merely lithographed and distributed among the members of the Academy. But I fear it is calculated to do far more harm than good from its displaying enthusiasm, and an inordinate love of the marvellous, whether true or false, instead of knowledge and judgment. It contains an Appendix, entitled, *A New Theory of Physics*, which any one acquainted with physics will perceive to be replete with mistatements and illogical inferences. Phrenology he abhors, and displays the grossest ignorance of it, making statements totally at variance

My readers will remember the extraordinary, but unquestionable, case of Colonel Townsend (*suprà*, p. 485. sqq.), who some

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with facts.* (Vol. ii. p. 120. sq., 150.) So credulous is he, that he considers the learned and amiable Swedenborg to have been naturally in a state of magnetic illumination, whom any one conversant with Swedenborg's theological writings, and with the history of insanity, must know to have been a monomaniac for thirty years. The mad Joan of Arc he supposes to have been in an habitual crisis. He believes every childish tale without a shadow of authenticity (vol. i. p. xxx. 87. sq.), every absurdity advanced by mesmerisers,—that mesmerised people speak, not merely understand, when spoken to by others influencing them mesmerically, languages unknown to them; he applies ridiculously extravagant terms of praise to ordinary persons, and considers a certain production as highly satisfactory, —just what he himself would have executed, — but which any man of sense and good feeling will agree with me to have been too contemptible, intel-

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* As a specimen of his knowledge and mind, I refer to a note in vol. ii. p. 153. He has "good reason to believe" that the brain is the seat of the operations of intellect, but equally good to hold "that the ganglionic system, the nerves of the chest and abdomen, is the primary seat of the affections!" Love, hate, jealousy, &c. alter the functions and even the structure of these organs, and any effect of these passions "upon the brain appears to be merely secondary and sympathetic!" Shame makes the cheek blush; shame therefore has its primary seat in the cheeks. We may go farther: disorder of the stomach causes headach; dyspepsia therefore has its primary seat in the head, and any effect produced upon the stomach appears merely secondary and sympathetic.

I must take this opportunity of supplying an omission on the subject of phrenology. All persons give Dr. Spurzheim the credit of inventing the term phrenology for his master's science: and he takes this credit, for, in his *Phrenology*, vol. i. p. 12., he says, "In extending my views, I have found it necessary to change the name again. I have chosen that of phrenology, which is derived from two Greek words, φρην, mind, and λογος, a discourse, and I understand by it the doctrine of the special phenomena of the mind, and of the relations between the mental dispositions and the body, particularly the brain." Now, Dr. Forster, in his *Recueil des Ouvrages et des Pensées d'un Physicien et Metaphysicien*, par Thomas Forster, Francfort sur le Mein, 1836, p. 12., proves that he himself gave the name: "I introduced my friend (Dr. Spurzheim) to the converzationi of Sir Joseph Banks, which were held every Sunday evening in Soho Square, and to many other men of science; but the greatest benefit I rendered him was to give him a suitable name for his system. In 1816 I published my *Sketch of the Phrenology of Gall and Spurzheim*, London, 1816; — a name which the science has never lost."

time before his death possessed the power of gradually reducing the action of his heart till it became imperceptible and for half

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lectually and morally, for me to condescend to notice. Materialism is as great a horror to him as phrenology; and he fancies that mesmerism proves the existence of a soul independent of body, and is doing wonders by weaning people "from the deadly error of materialism and infidelity, and giving birth to a sound and religious faith." (Vol. ii. p. 176.) He is thus ignorant that materialists may not only believe in God, but in the divine authority of Scripture; and more honour Scripture by looking implicitly in full faith to it alone, as God's authority, for their belief in a future state, than those who endeavour to make its declarations more probable by fancying a soul immortal in its own nature and independent of matter, when the Scripture tells us we shall rise as matter, — with bodies, and go to heaven with bodies, where Christ, God himself, sits bodily, — as matter, flesh, blood, and bones, in the words of the Church of England. (See my arguments at pages 39. sqq., 360. sqq.)

He supposes that, when Negretti had dressed a salad and then ate first cabbage and then tart instead, without perceiving the trick, and did not know that he was drinking water when he had called for wine, his "soul only was busy, without any co-operation of the body." (Vol. i. p. 344. sq.) Negretti's immaterial soul was resident in his brain, however, at the time, because Negretti was eating and drinking and doing a great many things with his body set in action by his brain, which was evidently hard at work. He conceives that in sleep there is always dreaming,— that the soul can never sleep, but is always at work; and that, when we are conscious of dreaming, it is only that the soul is struggling to manifest its independent activity without the co-operation of the bodily organs. (Vol. ii. p. 121.) It is a pity that the soul does not succeed; for, when acting only half followed by the brain, it works much worse than when completely so, our dreams being generally absurdities. (See *suprà*, p. 626.) I wonder why we should not recollect what our soul does in sound dreamless sleep without the co-operation of the brain: surely it must have memory. I wonder why, if it works so well without the brain, nature entangles it in a brain at all.

In mesmeric sleep-waking he contends that all has proceeded without the brain. The sleep-waker "remembers nothing, because the soul acts perfectly without the body, and every thing has taken place out of the brain, since we have seen that the fluid goes in search of objects." (Vol. ii. p. 159.; vol. i. p. 302.) In the subsequent fit, however, all is remembered, and yet the fluid must be again gone out in search. It must, therefore, be at home and abroad at the same time. So powerful does he believe the soul unencumbered by body to be in sleep-waking, that he actually declares not only that he is not aware of a sleep-waker perishing in the dangers which he frequently encounters, but that "so long as he is left undisturbed in his proceedings he acts fearlessly and is safe,"—"that he is protected from injury by other means and guarantees of security than those by which his conduct is regulated in his ordinary waking

an hour he appeared really dead. Bernier informs us that Indian Bramins and Fakirs can throw themselves into somnam-

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state." I have frequently read in the newspaper of persons opening the window and being dashed to pieces in their sleep. But, waving this, we saw that Negretti struck himself against a door which was shut without his knowledge, and once hurt himself severely against a wall (p. 640.): that Galen was awakened by striking against a stone: and that Mr. Dubree in his sleep threw himself out of the window and broke his leg. Besides the soul must be very stupid in sleep-waking, while it is doing the more wonderful things, — seeing with the surface, it is not aware of half that is existing and doing around. (See for instance *suprà*, p. 635. 637. 640. sq.) Supposing that persons perceive, independently of touch, by their surface, this shows no immaterial substance independent of matter to be at work, for the material surface is concerned in the operation. If the mesmerised person has intelligence of the past, present, and future, in regard to others as soon as they are put into relation with him by contact or intermediate communication, the unconnected, detached, immaterial substance must be a strange substance, which, to do these wonders, requires material bodies and their conjunction. At any rate, there is no *detached* immaterial essence at work. But I am weary of such nonsense. Any person of common discernment, unbewildered by fancies and unfettered by the intolerance of conceit and prejudice, must perceive that all the phenomena of sleep-waking are the effects of disorder of the matter called nervous system; coexist or are variously interchanged with all kinds of disorders of this part of the animal body; and are often attended by common bodily symptoms — heat, pain, throbbing, flushing of the head, &c.; and arise from the same causes as other nervous diseases, — mechanical injury, derangement of some distant part, &c.; and are sometimes hereditary. Brutes are influenced by mesmerism like human beings; and even vegetables, and inanimate matter. If mesmerism can act at a distance, so, let us remember, can gravitation, affinity, and other properties of inanimate matter. The soul, in the mesmerised, has disconnected itself from the brain! the fluid (is the fluid the soul? is not fluid still matter?) has gone out in search of objects! Where is it? and when out, how happens it to learn so little? to see only what is passing with respect to certain persons? to see only one person perhaps dying? or does the soul of the dying person go to its friends for a moment and show itself in those remarkable cases of the fancied sight of dying distant friends? The soul flies out under the manipulations of the magnetiser, and then flies away home again, knowing its way to the original skull, like a little material dickybird. Mr. Colquhoun's views are fit only for old divines and nursery maids. An enlightened Christian will scorn the support of any thing for his revelation but its plain evidences; these he will consider all-sufficient; and above all will he scorn the assistance of mesmerism, when he reflects, — a fact which Mr. Colquhoun does not mention, that some of the greatest mesmerists, — those who believe things which I will not believe till I see them, but which he believes, — contend that all the prophecies of the Old and New

bulism, and even teach the art.[f] Cardanus professed to be able to place himself in ecstatic insensibility.[g] St. Austin tells of a priest, named Restitutus, who could become insensible and lie like a dead man whenever he pleased, insensible to blows, punctures, burning, though if persons spoke loudly he heard something like distant sounds.[h] We have a modern account of a similar nature:—A man in India, "is said by long practice, to have acquired the art of holding his breath by shutting his mouth and stopping the interior opening of the nostrils with his tongue; he also abstains from solid food for some days previous to his interment; so that he may not be inconvenienced by the contents of his stomach, while put up in his narrow grave; and, moreover, he is sewn up in a bag of cloth, and the cell is lined with masonry and floored with cloth, that the white ants and other insects may not easily be able to molest him. The place in which he was buried at Jaisulmer is a small building about twelve feet by eight, built of stone; and in the floor was a hole about three feet long, two and a half feet wide, and the same depth, or perhaps a yard deep, in which he was placed in a sitting posture, sewed up in his shroud, with his feet turned inwards towards the stomach, and his hands also pointed inwards towards the chest. Two heavy slabs of stone, five or six feet long, and broad enough to cover the mouth of the grave, so that he could

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Testament, and all the miracles relating to the animal frame, were only so much mesmerism, and that Christ was but an extraordinary mesmeriser. A celebrated living mesmerist asserted this in a public lecture at Montpellier, and the people soon afterwards took up stones to stone him and endeavoured to drive him out of their city. Mr. Colquhoun himself quotes at great length a fierce tirade against the Bible, calculated, I should think, to produce great irreverence of the book.

Mr. Colquhoun would have rendered real service to mesmerism, if, instead of compiling so much rubbish, and displaying such ignorance and credulity, with a dogmatism and coarseness (vol. i. p. 136.; vol. ii. p. 162. sqq.) which have prevented me from being at all delicate with respect to him, he had collected unquestionable facts only and gone to work experimentally, like a philosopher, and communicated his results to the public.

[f] *Cérémonies et Coutumes rêligieuses*, t. vi. p. 188.

[g] "Quoties volo, extra sensum quasi in ecstasin transeo." *De rerum varietate*, l. viii. c. 43.

[h] *De civitate Dei:* all quoted in *Isis revelata*, vol. i. p. 146. sq.

not escape, were then placed over him, and I believe a little earth was plastered over the whole, so as to make the surface of the grave smooth and compact. The door of the house was also built up, and people placed outside, so that no tricks might be played nor deception practised. At the expiration of a full month, that is to say *this morning*, the walling of the door was broken, and the buried man dug out of the grave; Trevelyan's moonshee only running there in time to see the ripping open of the bag in which the man had been enclosed. He was taken out in a perfectly senseless state, his eyes closed, his hands cramped and powerless, his stomach shrunk very much, and his teeth jammed so fast together, that they were forced to open his mouth with an iron instrument to pour a little water down his throat. He gradually recovered his senses and the use of his limbs; and when we went to see him was sitting up, supported by two men, and conversed with us in a low, gentle tone of voice, saying that 'we might bury him again for a twelvemonth if we pleased.'" The narrator is Lieut. A. H. Boileau, an officer of engineers, employed on the extensive trigonometrical survey of India. The Indian is now alive, and he voluntarily agreed with Esur-Lal, one of the ministers of the Muharàwul of Jaisulmer, to be buried for a month. There may be after all some trick; but Cornet Macnaghten once suspended him for thirteen days in a close wooden box. Previously to his interments he takes milk only, and of that no more than is sufficient to support life: and during it his hair ceases to grow.[1]

Besides sleep, various diurnal revolutions take place in the animal system. We have seen that the pulse is generally thought to be quicker in the evening than in the morning: that the formation of carbonic acid in the lungs was found by Dr. Prout in experiments upon himself to increase from daybreak to noon, to decrease from noon to sunset: that muscular power in Dr. Edward's experiments increased during the first half of the day and decreased in the latter. I have noticed for twenty years a

[1] *India Journal of Medical and Physical Science.*

diurnal revolution in my intellect and feelings: in the morning my intellect is stronger, as is that of all persons necessarily after repose; but in the evening all my social feelings are strikingly more acute. I often am deeply distressed in the evening, when reflecting on the loss or absence of those dear to me, and at the misfortunes of others not connected with me, till the very moment I go to bed and fall asleep; and in the morning can reflect upon the very same things with coolness, and perhaps am indisposed to reflect upon them at all.

Again, brutes have their seasons, — periods in which certain propensities become ungovernable, — for travelling, for singing, building, for the joys of love.

Morbid phenomena frequently have periodical recurrences — fever, pain, epilepsy, &c.,— and the intermission may be hours, days, weeks, months, years.

All brutes, probably, except those whose life is of very short duration, sleep. They sleep, however, at different periods of the twenty-four hours; so that according to their waking period they have been divided into diurnal, crepuscular, and nocturnal. Though darkness is not the cause of sleep, its effect upon diurnal birds is strikingly shown, if darkness supervenes in the day: I have been amused to see my birds go to sleep in the morning during a solar eclipse, and awake again when it was over. Those which prey by night, like the cat, see better in darkness from the structure of their eyes, and pass the greater part of their time in sleep; while those which do not, are awake the greater portion of the twenty-four hours. The former are said to reverse their natural habits if in captivity, and to sleep at night. Carnivorous brutes sleep more than herbivorous. Most brutes, we are informed, sleep longer in winter than in summer. Brutes generally have a certain character of sleep; all hares, cats, birds (a goose is a far better night watch than a dog), &c. being light sleepers: bears, badgers, turtles, &c. heavy sleepers. Some, as the hare, always sleep with their eyes open (Dr. Macnish, p. 25. sqq.): some sleep well standing, and horses have been known to stand for thirty days. Those which eat at long intervals, as some reptiles, have been observed to sleep for days after their enormous meal.

Plants have been said to sleep, from periodic changes in the position of an entire leaf or of the several leaflets of which a compound leaf is formed. The leaf stalks bend upwards or downwards, so that the flattened surface of the leaf is elevated or depressed: the upper surface of some leaflets and the under of others is brought together. These changes are influenced by light and heat, but not primarily induced. For, in a darkened room, the leaflets of sensitive

plants periodically fold and open: if excluded from light by day, and exposed to strong lamp-light by night, the periods of sleep become irregular at first, but generally, at length, the leaves close by day and open at night. The alternate opening and closing of flowers is analogous, but take place at different periods in different species, and not at the same period with the same changes in the leaves. An acacia has closed its leaves and expanded its flowers at sunset, and expanded its leaves and closed its flowers at sunrise. (Prof. Henslow's *Principles of Descriptive and Physiological Botany*, in Lardner's *Cyclopædia*, p. 171. sq.)

The functions of plants are very periodical: leafing and flowering occur at certain periods. The regular return of the seasons influences their periodicity, but there is a natural independent tendency to it which, though assisted by the vicissitudes of the season, causes the changes of individuals to be considerably accelerated or retarded. (Prof. Henslow, l. c. p. 149. sq.)

The phenomena of hybernating animals, which grow dull on the approach of winter, and at length fall asleep, continuing so till the return of mild weather, and generally endeavouring to be as little exposed to noise, motion, and all causes of excitement, and to lose as little heat during the approaching cold as possible, by coiling themselves up and getting into holes and warm situations, covering themselves with leaves, &c. (and all the classes of animals, except birds, contain species that have the faculty of living in this state), are precisely analogous, though very different in degree, to those of common sleep. The sensibility and all the functions are lessened, the temperature becomes nearly as low that of the surrounding medium, the circulation slow, respiration almost or quite imperceptible, and digestion suspended. Although all activity is thus reduced in the hybernating state, vitality becomes more tenacious,—is less easily extinguished. Mangili cut off the head and neck of a marmot in the state of hybernation in March, and put it in spirits, yet movements were evident in it at the end of half an hour, and galvanism produced strong contractions in pieces of voluntary muscles three hours after they had been cut off; and even *four* elapsed before their excitability was much diminished: the heart beat for three hours after decapitation. He made the same examination in June with a marmot which had been out of hybernation two months; the muscles showed little excitability under galvanism at the end of *two* hours, and the heart ceased to beat in fifty minutes after decapitation. (*Annales de Museum*, t. x. p. 453. sqq.) This is what we should have expected. The augmented tenacity of life, which allows food, air, and heat to be dispensed with in whole or in part, is likely to pervade the muscles and indeed every part of the frame; just as the necessity for air, food, and heat is in all other cases proportionate to the want of tenacity of excitability in muscles and of all vital properties. The sensibility is not so diminished but that "the slightest touch applied to one of the spines of the hedgehog immediately roused it to draw a deep and sonorous inspiration; the merest shake" induces a few respirations in the bat. (Dr. Marshall Hall, *Phil. Trans.* 1832.*)

* This gentleman endeavours to show that an inverse ratio prevails between respiration and irritability, in which word he includes both tenacity and sus-

This torpidity is produced by a *deficiency* of external excitants, usually by cold and want of food, and, in the language of Brown, is a state of direct debility, while our ordinary sleep is one of *indirect* debility, — exhaustion. No structural peculiarity is discoverable, which enables certain animals to exist in the torpid state.

Such animals at all times produce less heat, and vary more with the surrounding medium, than others, so that Dr. Edwards in an hour cooled a dormouse 36° by surrounding it with a freezing mixture, which caused a reduction of not more than 5° or 6° in adult birds and guinea-pigs exposed to it for even a longer time. (l. c. p. 154. sq.) Some which do not hybernate resemble them in this inferior power; mice, for example, which, therefore, at all ages and seasons make themselves nests. (p. 259.) On the other hand, hybernating animals are not all equally deficient in the power of resisting the influence of surrounding low temperatures; dormice are the most so, marmots the least; so that animals which preserve their own temperature in low media, and those which readily follow the surrounding temperature, are not widely separated, but insensibly run into each other, (l. c. p. 257. sq.) to say nothing of the inferior power of the newly-born among many of the former, and among all if born before full time, and of the various degrees of this power in different adults, and in all at different seasons of the year. (See section on animal heat.) Cold produces sleep in all, and if the sleep is indulged, death is the result in those which cannot hybernate. Those which can, become more and more torpid, by the mere continuance of the same degree of cold. A very intense degree of cold has been found actually to arouse animals in a state of torpidity, but the excitement of the functions could not continue long, and death ensued. (p. 398.) It appeared necessary that respiration should be suspended in an experiment of M. De Saissy, who, by mere cold, could not produce torpor in a marmot till he closed the lid of the vessel in which it was placed. (p. 154.) Hence, exposure to carbonic acid, hydrogen, &c., in this state, was found by Spallanzini to have no ill effect upon a torpid marmot. (*Rapports de l'Air*, t. ii. p. 207.) Yet respiration has often seemed not to cease entirely. (See Dr. Reeve, *Essay on the Torpidity of Animals.*) The blood has been found in a certain degree coagulated in torpid bats. (Hunter, *On the Blood*, p. 25.) Cold, at any time of the year, will produce the torpid state, but want of food must greatly assist in lessening the power of maintaining temperature. On the other hand, a continual good supply of food and warm temperature increases their power of evolving heat, and enables them to resist the power of cold, so that, by domestication, some cease to hybernate in the winter. (Dr. Edwards, l. c. p. 472.) Dr. Edwards found that the temperature of hybernating animals sinks considerably during sleep, even in summer. (p. 473.)

Fish, and other cold-blooded animals, will survive an intense torpidity. "The fish froze," says Captain Franklin, "as fast as they were taken out of the nets,

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ceptibility. I conceive that the whole is but one fact: — that animals which retain their powers well under privations, must be those which require less frequent and less abundant supplies of food, air, &c.; and that respiration is less in them from the less necessity of stimuli to support the system.

and in a short time became a solid mass of ice, and by a blow or two of the hatchet were easily split open, when the intestines might be removed in one lump. If in this completely frozen state, they were thawed before the fire, they recovered their animation." "We have seen a carp recover so far as to leap about with much vigour, after it had been frozen for six and thirty hours." (*Journey to the Polar Sea*, p. 248.) Izaak Walton (*The Complete Angler*, p. 257.) quotes Gesner for the fact of some large breams being put into a pond which was frozen the next winter into one mass of ice so that not one could be found, and all swimming about again when the pond thawed in the spring, — a thing "almost as incredible," says the sentimental sinner, as Lord Byron calls him, "as the resurrection to an atheist."

Insects easily bear torpidity from cold. In Newfoundland, for example, Captain Buchan saw a frozen lake, which in the evening was all still and frozen over, but, as soon as the sun had dissolved the surface in the morning, was in a state of animation, owing, as appeared by close inspection, to myriads of flies let loose, while many still remained "infixed and frozen round." Ellis also mentions that a large black mass, like coal or peat, upon the hearth, dissolved, when thrown upon the fire, into a cloud of musquitoes. (*Quarterly Review*, 1821, April, p. 200.) Those insects which hybernate are not thought by Kirby and Spence (*Entom.* vol. ii. p. 460. sqq.) to prepare for and enter into that state solely from cold, &c., as they do so when the season comes round, although the weather be as warm as previously, and do not before this period, though the temperature chance to be as low as it usually is in the season of hybernation.

Some animals become torpid on being deprived of moisture, — the most simple infusoria, rotifera, vibriones for instance. A common garden snail falls torpid if put in a dry place, and may be revived at any time by the application of a little water. Moisture has revived some animalcules after a torpidity of twenty-seven years. (Spallanzani, *Opuscoli di Fisica animale e vegetabile.*) The same is true of some of the most simple vegetables, as mosses. The microscopic wheel animal, after remaining three or four years as a shrivelled point, capable of being broken to pieces like a crystal of salt, is still recoverable by a drop of water: and the eel of blighted corn (*vibrio*), after twenty or thirty years. Yet electricity destroys their capability of resuscitation. Most vegetables become torpid in winter. Many lichens and mosses, dried in herbaria, have been restored to life by moisture after a century or two. Seeds and bulbs which have remained for centuries in the bowels of the earth have sprung into life on being thrown into a more congenial soil: and bulbs, taken from the hand of a mummy found in one of the pyramids, after having been immured between two and three thousand years, produced unknown plants when sown in one of our botanic gardens. (Dr. Fletcher, l. c. P. ii. b. p. 144.) Still more lately, a writer of rank, Baron Herberstein, who was twice ambassador in Russia from the Emperor Ferdinand, informs us, in his *Commentaries on Russian History*, that, in the northern parts of Muscovy, near the Oby, on the borders of Tartary, a people called Leucomori hybernate "like tortoises, under ground," "quite frozen," from the 27th of November to the 23d of April, when "they come to life again." No specimens have yet been imported into this country.